sipri

ARMS-PRODUCTION CAPABILITIES IN THE INDO-PACIFIC REGION

Measuring Self-reliance

LUCIE BÉRAUD-SUDREAU, XIAO LIANG,
SIEMON T. WEZEMAN AND MING SUN

STOCKHOLM INTERNATIONAL
PEACE RESEARCH INSTITUTE

SIPRI is an independent international institute dedicated to research into conflict, armaments, arms control and disarmament. Established in 1966, SIPRI provides data, analysis and recommendations, based on open sources, to policymakers, researchers, media and the interested public.

The Governing Board is not responsible for the views expressed in the publications of the Institute.

STOCKHOLM INTERNATIONAL
PEACE RESEARCH INSTITUTE

ARMS-PRODUCTION CAPABILITIES IN THE INDO-PACIFIC REGION

Measuring Self-reliance

LUCIE BÉRAUD-SUDREAU, XIAO LIANG,
SIEMON T. WEZEMAN AND MING SUN

STOCKHOLM INTERNATIONAL
PEACE RESEARCH INSTITUTE

October 2022

Contents

List of Tables

Acknowledgements

This activity was supported by the Australian government through a grant from its Department of Defence. The views expressed here are those of the authors and are not necessarily those of the Australian government or the Department of Defence.

Summary

Armed forces in the Indo-Pacific region remain dependent on weapon systems imported from foreign suppliers: of the world's five largest arms importers during 2016–20, three were in this region. This is despite many governments in the Indo-Pacific having implemented policies to support the development of local arms industrial capabilities with the aim of increasing self-reliance. Although few states have the capability and resources to set up an arms industry capable of supplying all the needs of their armed forces, it is increasingly relevant to determine how close the governments in the region can approach such self-reliance.

Three indicators can be used to assess the level of self-reliance in arms production. The first indicator is domestic and licensed production as shares of the total acquisitions of major arms between 2016 and 2020. The second indicator is the size of domestic arms-producing and military services companies. The third indicator is capabilities in emerging military technologies, as represented by progress in the research and development of uncrewed surface vehicles (USVs) and uncrewed underwater vehicles (UUVs). These three indicators are combined to give a score and regional ranking for self-reliance for 12 case studies in the Indo-Pacific region: Australia, China, India, Indonesia, Japan, South Korea, Malaysia, Pakistan, Singapore, Taiwan, Thailand and Viet Nam. Viet Nam could not be included in the final ranking due to a lack of data.

The results reveal wide disparities. There is generally more self-reliance in East Asia—China (rank 1), Japan (rank 2) and South Korea (rank 3)—than in South East Asia—Indonesia (rank 9), Malaysia (rank 10) and Thailand (rank 11). China, Japan and South Korea are among the 4 largest military spenders in the 12 case studies. China dominates the ranking, reaching a self-reliance score more than two and a half times higher than Japan's. In the case of the three South East Asian states, imports as a share of total procurement remain close to 100 per cent, but they have implemented a policy of diversifying arms suppliers to avoid being overly dependent on only one supplier. For these countries, developing maintenance, repair and overhaul (MRO) capabilities is one way to enhance self-reliance while domestic production remains limited.

Taiwan (rank 5), Australia (rank 6) and Singapore (rank 7) are in the middle ground between these two subregional groupings, which is in line with their relatively high level of military spending. In South Asia, India (rank 4) and Pakistan (rank 8) vary widely in terms of the size of their domestic arms companies, but the level of licensed production is relatively high in both states.

There are opportunities for cooperation in the Indo-Pacific in emerging military technologies, for example, in naval autonomous technologies. In the domain of USVs and UUVs, most projects are still at the development stage and their operationalization remains limited. Pooling and sharing of resources and knowledge could prove fruitful when it comes to applications of these technologies for operations other than war, such as counter-piracy and humanitarian and disaster relief missions, which could provide common ground for cooperation in the region.

The flow of arms between states is widely used as an indicator in international confidence-building and arms control instruments. To some extent, monitoring arms flows only remains relevant for states where imports still compose a large proportion of their total acquisitions. For others, it is not sufficient to generate a full picture of their armament developments. Existing and future international confidence-building and arms control instruments should thus also try to capture domestic arms-production capabilities.

Overall, this report contributes to knowledge and debates on armament trends and military modernization in the Indo-Pacific on three counts. First, it provides a

quantitative assessment of national self-reliance in arms production in the region in terms of the relative size of arms companies and the proportion of domestic weapon systems in total arms procurement. Second, it introduces an aspect of arms-production capabilities that has so far been largely underestimated and where the literature is still scant: the industrial dimension of emerging military technology. In this regard, the comparison of programmes for naval autonomous systems in the Indo-Pacific region and their levels of development is an important contribution. Third, in a region where tensions among neighbours are rising, this report contributes to transparency with regards to levels of self-reliance in domestic arms production, allowing for an independent assessment of the region's respective arms industries.

Abbreviations

AI	artificial intelligence
APC	armoured personnel carrier
ASEAN	Association of Southeast Asian Nations
ASW	anti-submarine warfare
ATLA	Acquisitions, Technology and Logistics Agency (Japan)
ATT	Arms Trade Treaty
AUV	autonomous underwater vehicle
C4ISR	command, control, communications, computers, intelligence, surveillance and reconnaissance
DAPA	Defense Acquisition Program Administration (South Korea)
DOD	Department of Defence (Australia)
DTI	Defence Technology Institute (Thailand)
DPSU	Defence Public Sector Undertaking (India)
DSME	Daewoo Shipbuilding & Marine Engineering (South Korea)
KAI	Korea Aerospace Industries
KHI	Kawasaki Heavy Industries (Japan)
MHI	Mitsubishi Heavy Industries (Japan)
MND	Ministry of National Defence (Taiwan, Viet Nam)
MOD	Ministry of Defence (India, Japan, Singapore, Thailand)
MODP	Ministry of Defence Production (Pakistan)
MRL	multiple rocket launcher
MRO	maintenance, repair and overhaul
NCSIST	National Chung-Shan Institute of Science and Technology (Taiwan)
PLA	People's Liberation Army (China)
R&D	research and development
SME	small to medium-sized enterprise
SOE	state-owned enterprise
TIV	trend-indicator value
UAV	uncrewed aerial vehicle
UCAV	uncrewed combat aerial vehicle
UNROCA	United Nations Register of Conventional Arms
USV	uncrewed surface vehicle
UUV	uncrewed underwater vehicle

1. Introduction

The geographic region with the longest uninterrupted streak of military expenditure increases is Asia and Oceania, with continuous growth since the late 1980s.[1] The growth of resources that the states in the region have dedicated to their armed forces has resulted in improved military capabilities, as evidenced by the introduction of increasingly modern weapon systems.[2] Eighteen arms-manufacturing firms based in the Indo-Pacific region ranked among the world's 100 largest arms companies in 2020.[3] Similarly, China and the Republic of Korea (South Korea) are among the world's 10 largest arms exporters.[4]

At the same time, armed forces in the Indo-Pacific region remain dependent on weapon systems imported from foreign suppliers: three of the world's five largest arms importers during 2016–20 were Indo-Pacific states: India, Australia and China. This dependence persists even though many governments in the Indo-Pacific have adopted and implemented policies to support the development of local arms industrial capabilities with the aim of increasing self-reliance.[5]

Full self-reliance refers to a state's capability to domestically design and produce military goods across the entire spectrum of its armed forces' requirements, with no input of foreign technology. Full self-reliance is arguably impossible to achieve: few states have the capability and resources to set up an arms industry capable of supplying all the needs of their armed forces. Even the United States, the world's largest arms producer, still relies on foreign resources for its arms production.[6] Nonetheless, maintaining local arms-manufacturing and repair capabilities allows states to sustain their forces' equipment in case of supply disruptions and provides limited capability for military adaptation and innovation.[7] However, this would represent a low level of ambition compared to the maximum possible self-reliance. The degree of self-reliance must also be put in the context of broader security relations. For instance, Australia imports a large share of its weapon systems from the USA (see table 1.1) but benefits from security guarantees and high-end weapon systems.

Determining how close the various states in the Indo-Pacific region can approach self-reliance in arms production is increasingly relevant. It is a crucial topic for confidence-building measures in a region with ongoing territorial disputes and mutual distrust.[8] Existing international instruments—such as the 2013 Arms Trade Treaty

[1] SIPRI Military Expenditure Database, Apr. 2022. See also Lopes da Silva, D. et al., 'Trends in world military expenditure, 2021', SIPRI Fact Sheet, Apr. 2022.

[2] Lee, S., *Explaining Contemporary Asian Military Modernization: The Myth of Asia's Arms Race* (Routledge: Abingdon, 2021), specifically chapter 3; and Béraud-Sudreau, L., 'Rising military expenditure in Asia: Towards greater strategic autonomy?', eds W. Choong and T. Huxley, *Asia–Pacific Regional Security Assessment 2018* (International Institute for Strategic Studies (IISS): London, June 2018).

[3] SIPRI Arms Industry Database, Dec. 2021. See also Marksteiner, A. et al., 'The SIPRI Top 100 Arms-producing and Military Services Companies, 2020', SIPRI Fact Sheet, Dec. 2021.

[4] SIPRI Arms Transfers Database, Mar. 2022. See also Wezeman, P. D. et al., 'Trends in international arms transfers, 2021', SIPRI Fact Sheet, Mar. 2022; and Béraud-Sudreau, L. et al., 'Emerging suppliers in the global arms trade', SIPRI Insights on Peace and Security no. 2020/13, Dec. 2020.

[5] On South East Asia see Bitzinger, R. A., 'Revisiting armaments production in Southeast Asia: New dreams, same challenges', *Contemporary Southeast Asia*, vol. 35, no. 3 (Dec. 2013). On China, India, South Korea and Taiwan see Bitzinger, R. A., *Arming Asia: Technonationalism and its Impact on Local Defense Industries* (Routledge: Abingdon, 2017).

[6] Brooks, S. G., *Producing Security: Multinational Corporations, Globalization, and the Changing Calculus of Conflict* (Princeton University Press: Princeton, NJ, 2005), cited in Kurç, Ç. and Neuman, S. G., 'Defence industries in the 21st century: A comparative analysis', *Defence Studies*, vol. 17, no. 3 (2017), p. 222. E.g. China is a key supplier of chemicals for US missiles. See US Interagency Task Force, *Assessing and Strengthening the Manufacturing and Defense Industrial Base and Supply Chain Resiliency of the United States* (US Department of Defense: Arlington, VA, Sep. 2018), p. 49.

[7] DeVore, M. R., 'Arms production in the global village: Options for adapting to defense-industrial globalization', *Security Studies*, vol. 22, no. 3 (2013); and DeVore, M. R., 'Armaments after autonomy: Military adaptation and the drive for domestic defence industries', *Journal of Strategic Studies*, vol. 44, no. 3 (2021).

[8] On the tensions see e.g. Person, J., 'Explainer: What's behind rising tensions in the South China Sea?', Reuters, 16 July 2020; and Duchâtel, M., Bräuner, O. and Seibel, K., 'Maritime disputes in the South and East China seas', *SIPRI*

Table 1.1. Regional ranking for arms exports, arms imports and military spending in the Indo-Pacific region

Country	Regional rank as exporter, 2016–20	Regional rank as importer, 2016–20	Largest supplier (share of total arms imports)	Military spending, 2021 (current US$ m.)	Regional rank in spending, 2021
Australia	3	2	United States (69%)	31 754	5
China	1	3	Russia (77%)	293 352	1
India	4	1	Russia (54%)	76 598	2
Indonesia	5	8	United States (23%)	8 259	9
Japan	14	6	United States (97%)	54 124	3
South Korea	2	4	United States (58%)	50 227	4
Malaysia	n.a.	16	Spain (32%)	3 830	13
Pakistan	13	5	China (72%)	11 305	8
Singapore	7	9	France (43%)	11 115	7
Taiwan	12	15	United States (100%)	12 958	6
Thailand	15	10	South Korea (25%)	6 605	10
Viet Nam	11	7	Russia (66%)	.. (5 500 in 2018)	..

n.a. = not applicable.

Note: Regional ranking is based on the 44 jurisdictions in Asia and Oceania as defined in SIPRI databases, 'Regional coverage', [n.d.].

Sources: SIPRI Arms Transfers Database, Mar. 2022; and SIPRI Military Expenditure Database, Apr. 2022.

(ATT) and the United Nations Register of Conventional Arms (UNROCA)—focus mainly on control of the arms trade and regulating the flow of weapon systems. They have severe limitations when it comes to monitoring domestic arms production. Yet, as states seek to improve their own arms-production capabilities, procurement from domestic suppliers needs to be monitored closely in order to understand armament developments. The topic of self-reliance is thus key to understanding trends in weapon acquisitions.

Despite the perceived benefits, developing a domestic arms industry is a demanding endeavour. It requires significant investment in local firms over a long period of time, with no guarantee that additional military capabilities will be delivered. As Andrew Moravcsik puts it, 'nearly every state faces the autarky–efficiency dilemma—the inescapable fact that greater autonomy can be bought only at the price of reduced efficiency in armament production'.[9]

Despite the high costs and the limited prospect of success, several factors explain why countries seek to achieve greater self-reliance in arms production. According to Keith Krause, these include the pursuit of wealth, power and victory in war, while Stephanie Neuman and Çağlar Kurç identify prestige as another motive.[10] Since development of domestic arms-production capacities creates highly skilled jobs and means that procurement budgets can be spent in-country, states pursue these capacities for economic gains.[11] Notably in Asia, as Richard Bitzinger argues, the development of a local arms industry was perceived and justified as a means not only to increase self-reliance in the defence realm, but also to create spin-off effects. The latter were intended to move local economies up the technological ladder and improve skills and competences domestically in advanced sectors.[12] States also use self-reliance to try

Yearbook 2015: Armaments, Disarmament and International Security (Oxford University Press: Oxford, 2015).

[9] Moravcsik, A., 'Arms and autarky in modern European history', *Daedalus*, vol. 120, no. 4 (fall 1991), p. 23.

[10] Krause, K., *Arms and the State: Patterns of Military Production and Trade* (Cambridge University Press: Cambridge, 1992), pp. 13–17; and Neuman, S. G. and Kurç, Ç., 'Conclusion: The need for continuous in-depth and comparative study', *Defence Studies*, vol. 17, no. 3 (2017), p. 318.

[11] The literature has found contradicting evidence regarding the positive economic benefits of indigenizing arms production, notably when it comes to the impact of offsets. See Brauer, J. and Dunne, J. P., 'Arms trade offsets and development', CORE, June 2005; and Hsu, Y. C. and Lee, C. C., 'The impact of military technology transfer on economic growth: International evidence', *Applied Economics*, vol. 44, no. 19 (2012).

[12] Bitzinger, R. A., 'Asian arms industries and impact on military capabilities', *Defence Studies*, vol. 17, no. 3 (2017).

to insure themselves against a supplier's decision to cut deliveries, thereby becoming free from external influence.

The pursuits of wealth and power combine into what has been termed a 'techno-nationalist' policy. Techno-nationalism is when a mix of prestige and economic development considerations drives governments to invest and support a domestic arms industrial base.

So, on the one hand, Indo-Pacific states have attempted to boost their local arms industry; but, on the other hand, full self-reliance is impossible to achieve even for the world's major arms producers. This leaves the question: how far have Indo-Pacific countries progressed on the path towards self-reliance in arms production?

The report aims to increase knowledge on the arms industries and growing military capabilities in the Indo-Pacific region. While there is extensive literature on the policies to develop and support domestic arms industries, research is less developed when it comes to their results.[13] There has been some analysis, notably by Bitzinger, on how countries in the Indo-Pacific were able to develop local arms-production capabilities.[14] This report complements these existing studies by developing a detailed assessment of arms industrial capabilities in the Indo-Pacific region. As well as compiling quantitative data on the state of the local arms industries in the region, the report further introduces an aspect of arms-production capabilities so far largely underestimated and where the literature is still scant: the production of emerging military technologies.[15]

To do so, it studies 12 cases: Australia, China, India, Indonesia, Japan, South Korea, Malaysia, Pakistan, Singapore, Taiwan, Thailand and Viet Nam. As well as having identified arms-production capabilities, these 12 case studies have among the highest military expenditures in the Indo-Pacific region (see table 1.1). Despite its domestic arms-production capabilities, lack of data means that the Democratic People's Republic of Korea (DPRK, or North Korea) cannot be included.

Chapter 2 of this report presents the three indicators used to evaluate and compare self-reliance in arms production, describing their methodology, sources and limitations. The chapter also explains how the three indicators are combined to provide an overall ranking of self-reliance in the Indo-Pacific region. Chapters 3–14 present the results country by country. For each of the 12 case studies, the corresponding chapter first provides a short overview of the state's self-reliance goals and arms industrial policies, and then turns to each indicator. Chapter 15 concludes by providing a comparative assessment, combining the results of the three indicators to rank the 12 governments by their degree of self-reliance. It ends by summarizing the policy and research conclusions of the study.

[13] For instance, Lowy's Asia Power Index, does not include the arms industry as one of its indicators. It is only in recent years that the 2 public rankings of the global arms industry (by *Defense News* and SIPRI) have included Chinese arms companies.

[14] Bitzinger (note 12); and Bitzinger, R. A., 'Defense industries in Asia and the technonationalist impulse', *Contemporary Security Policy*, vol. 36 no. 3 (2015).

[15] One notable exception is Dunne, P. J. and Sköns, E., 'New technology and the US military industrial complex', *Economics of Peace and Security*, vol. 16, no. 2 (2021).

2. Methodology

The report develops three indicators to assess a state's self-reliance in arms production, related to procurement, large arms companies and emerging military technologies.[16]

Indicator 1. Procurement of major arms: imports, licensed production and domestic production

The first indicator measures imports and licensed and domestic production as a proportion of each government's total procurement of major conventional arms. This is the most direct measure of self-reliance as it measures the extent to which a state is dependent on arms imports for its armed forces.

Domestic production is understood as the production of locally designed weapons. It may still include foreign support and components, but the key aspect is where the design takes place. This is distinct from licensed production, which refers to foreign-designed weapons that are produced partly or entirely locally (with a local production input). Arms imports include sales, manufacturing licences, aid, gifts, and most loans or leases of foreign-designed major arms. Licensed production is a subset of imports.

The report applies the definition of 'major conventional arms' (or 'major arms' for short) used for the SIPRI Arms Transfers Database.[17] Data collection is based on open sources, including official documents and statements, media articles and various public information sharing platforms.

To measure the volume of actual procurements, the report applies SIPRI's system of trend-indicator values (TIVs). The specific TIV of each weapon represents its value as a military resource. The TIV of an arms acquisition does not represent its financial value. 'Second-hand' and 'second-hand but significantly modernized' arms are given a reduced TIV. For this study, total TIVs for the five-year period 2016–20 are calculated.[18]

The TIV methodology, while helpful to compare and track flows of weapon systems over time and across countries, presents some limitations. For the specific purposes of this report, which is measuring self-reliance, TIVs may to some extent introduce a bias in the analysis towards larger systems with higher TIV values. For example, it could be that a certain country acquires large quantities of domestically produced armoured personnel carriers (APCs), light artillery systems or trainer aircraft, but it imports just one submarine. Since the latter has a much higher TIV than the former, that country would appear to have relatively low self-reliance in arms acquisitions. However, the TIV value reflects the technological advancement of a weapon system, which is an important aspect of self-reliance in terms of military capabilities. To address this limitation, for those states where such a breakdown is relevant (China, India, Japan and South Korea), an additional table is provided disaggregating total acquisitions according to selected categories of major arms.

[16] Due to space constraints, the full list of sources consulted for each indicator is not included in this report. However, it is available upon request to the authors.

[17] For a detailed list of the weapon systems covered see SIPRI Arms Transfers Database, 'Sources and methods', [n.d.].

[18] For more information on the TIV and how it is calculated see SIPRI Arms Transfers Database (note 17); and Holtom, P., Bromley, M. and Simmel, V., 'Measuring international arms transfers', SIPRI Fact Sheet, Dec. 2012.

Indicator 2. The largest domestic arms-producing and military services companies

The second indicator provides an overview of the domestic arms-producing and military services companies ('arms companies' for short) by presenting the five largest arms companies of each state, where data is available. Companies are ranked by their sales of arms and military services in 2020 ('arms sales' for short), combining turnover from both domestic and export customers. The methodology and sources for this second indicator are identical to those applied for the SIPRI Arms Industry Database: 'arms sales' are thus defined as sales of military goods, services, and research and development (R&D) to military customers domestically and abroad.[19] Note that the first indicator includes only transfers of major conventional arms, not small arms or military services, which are covered by this second indicator.

This indicator complements the first one to the extent that the domestic arms industry is the major implementor of a country's self-reliance policies and the direct beneficiary of the government's investment. Therefore, the size of the arms industry is a good indication of a country's capability to design and produce its own weapon systems. While it is not possible to measure for each country the total size of the industry, the top 5 companies in each can be used as a proxy measure.

The lists of arms-producing and military services companies in this report include state-owned, publicly listed and private companies but excludes manufacturing or maintenance units of the armed services (e.g. the production factories of the Thai Army). Military services do not include contractors of the armed forces that provide only non-military services, including infrastructure, technical and management support (e.g. Australia's Lendlease, a construction and asset-management contractor).

A foreign-owned company with local management, R&D and production is considered to be a company of the state in which it is located. To some extent, this represents one limitation of using the size of arms companies as an indicator of self-reliance. It was beyond the scope of this study to determine how foreign ownership affects a country's self-reliance, given that the extent to which a foreign owner could limit access to technology depends, for instance, on the legal agreements related to each company or the level of independence of subsidiaries. This applies in particular to Australia, where the largest firms are all foreign owned.

For each country case study, subsidiaries of foreign companies in the country are included, but not the full subsidiaries of local companies in that country. For example, BAE Systems Australia is counted since it is an Australian subsidiary of the British company BAE Systems, but the Japan-based subsidiaries of the Japanese company Mitsubishi Heavy Industries (MHI) are not counted separately in the case of Japan.

The data on most companies was collected independently by the authors, based on SIPRI's own assessment and using open sources. These include mainly company annual reports and websites, specialized news outlets, press releases, marketing reports, and government publications of contract awards. In some cases, the data on arms sales represents what a company considers to be the 'defence' share of its total sales. In other cases, SIPRI uses the figure for the total sales of a 'defence' division, which may include some unspecified civilian sales. When such data is not reported by a company, arms sales are estimated based on, for example, contract awards and general information on a company's arms-production and military services programmes. When the data comes from secondary sources, this is specified in the relevant tables.

[19] For more details see SIPRI Arms Industry Database, 'Sources and methods', [n.d.].

The research conducted for this second indicator allows for the ranking of the top 50 companies in the Indo-Pacific region. This list contributes to the comparative assessment of self-reliance of the 12 case studies.

Indicator 3. Arms production and emerging military technologies: The example of uncrewed maritime vehicles

The third indicator is more qualitative. It provides an overview of available information in open sources on the 12 governments' efforts in developing uncrewed maritime vehicles: both uncrewed surface vehicles (USVs) and uncrewed underwater vehicles (UUVs). This indicator explores yet another, more granular dimension of self-reliance in arms production insofar as it attempts to generate data on how countries rely on domestic research institutes and firms to produce such systems, rather than on foreign technology and assistance.

The focus on the maritime domain was chosen over autonomous aerospace or land systems since the Indo-Pacific region 'is largely a maritime theatre, and most flashpoints involve maritime territory, features, and resources'.[20] Cutting-edge naval technology is likely to become a more important component of naval equipment inventories in the future. While development of uncrewed aerial vehicles (UAVs) is arguably as significant for long-range operations in the Indo-Pacific, they are already more commonplace in forces' inventories.

This indicator covers USVs and untethered UUVs. USVs can be used by the military as launching platforms for some small underwater vehicles or for conducting inshore operations. Untethered UUVs (also known as autonomous underwater vehicles, AUVs) operate beneath the sea without physical connections to a mothership, completing missions such as surveillance or mine countermeasures. A USV can be both autonomous and remotely operated, but a UUV can only be one or the other, not both. Remote control means that there is a human operator who directly controls the system—albeit at a distance. Autonomy, however, means that the system can operate without direct human operation. There can be varying degrees of autonomy depending on a given system's tasks and missions.[21]

Each case study provides a review of the country's stated interests in developing or procuring USVs and UUVs, based on official policy documents where available. It then lists military-related USV and UUV projects, with a focus on those programmes that attempt to integrate autonomous capabilities for a wide range of missions. Sources for this information typically include national defence strategies, navy action plans and local news coverage of developments of specific weapon systems.

There are inherent limitations to this indicator. Most notably, while this survey relies on open sources, information on some R&D programmes for USVs and UUVs may not be available in the public domain. In addition, all projects are counted equally in their evaluation and without accounting for their level of technology or military capabilities. Programmes for civilian applications are not included, even when these may have potential military applications.

[20] Lee (note 2), p. 3.

[21] Huang, H. (ed.), *Autonomy Levels for Unmanned Systems (ALFUS) Framework*, vol. I, *Terminology*, version 1.1, National Institute of Standards and Technology (NIST) Special Publication no. 1011 (NIST: Gaithersburg, MD, Sep. 2004).

Converting the indicators into an index to compare self-reliance

Results from the three indicators are combined in chapter 15 to provide a ranking of the 12 cases, from the most to the least self-reliant in arms-production capabilities (table 15.1).

To do so, the first indicator is disaggregated into two sub-indicators: sub-indicator 1(a) measures the share of domestic production in total arms procurement; and sub-indicator 1(b) is the share of licensed production in total arms procurement. Both reflect a dimension of self-reliance, whereas imports of complete products show dependence. Sub-indicator 1(b), for licensed production, is attributed half the weight of sub-indicator 1(a) because, while it does provide an indication of self-reliance, it is further from the goal of 'full' independence than domestic production.

The second indicator relates to each state's largest arms companies, measured in terms of their arms sales. It also is divided into two sub-indicators: sub-indicator 2(a) is the state's share of the total turnover of the regional top 50 (table 15.2); and sub-indicator 2(b) measures the total arms sales of each state's three largest arms companies. The indicator includes three companies and not five as this allows comparison of those countries for which data availability is limited to fewer than five companies.

The third indicator relates to states' self-reliance in the field of uncrewed naval technologies. Assigning the same weight to this dimension as to the others would introduce a bias: first, because the qualitative assessment is limited by data availability; and, second, because some may have capabilities for applications of autonomy to military systems but could have focused on aerospace rather than the naval domain. This overall indicator is therefore assigned one-quarter of the weight of the other two indicators. For each project, the key questions are whether it is developed by local entities or with foreign assistance, and what level of development it has reached. Projects are categorized either as 'under development' (from planned phase to prototype, whether it is a technology demonstrator or a fully fledged programme) or 'in service'. Domestic projects that are in service in the local navy are allocated 2 points; domestic projects that are under development are allocated 1 point. International cooperation projects involving domestic entities are allocated 0.5 points, regardless of whether they are in service or under development. Purely foreign projects do not get any points. This provides a total number of points for each country case study.

All three indicators are re-based to score between 0 (minimum value) and 100 (maximum value). The final ranking is presented in table 15.1 in chapter 15.

Please note that totals in the tables for total procurement of major conventional arms (found in each case study) and totals in the table for overall ranking (i.e. table 15.1) may not add up to stated totals because of rounding conventions.

3. Australia

Australia's Defence White Papers have long revolved around the concept of 'self-reliance'.[22] While this was understood as being distinct from the notion of 'self-sufficiency', which would involve procuring the full range of weapon systems domestically, the latest iterations of Australia's defence policy papers in 2016 and 2020 re-emphasize the need to develop local capabilities.[23] The 2018 Defence Industrial Capability Plan outlines sovereign capabilities where the Australian government wanted to invest in local capacity.[24] Australia particularly emphasizes naval shipbuilding capabilities, as evidenced by the 2017 Naval Shipbuilding Plan.[25]

Arms procurement

Australia remains highly dependent on arms imports—it was the world's fourth largest importing state over 2016–20. Imports accounted for 98 per cent of the total volume of procurements for the period (see table 3.1).

In accordance with the government's arms industrial strategy, import contracts generally involve local industry in the procurement programmes. Local industry was involved in the production of 69 per cent of Australia's imports (68 per cent of total procurement). This was the case for the Hobart-class destroyers (built under licence from Spain) and components for the F-35A combat aircraft and P-8A anti-submarine warfare (ASW) aircraft (both imported from the United States). This is also a feature in the planned procurement of nuclear-powered submarines (from the USA or the United Kingdom), which is expected to benefit South Australian shipyards, and in the objective announced in 2021 to build sovereign capacity for guided weapons.[26]

Domestic designs accounted for less than 2 per cent of Australia's arms procurement in 2016–20. This included two patrol craft at the lower end of technology but also highly advanced radars for six frigates at the high end of technology. Ongoing programmes show a similar mix. At the lower end, over 1000 Hawkei light armoured vehicles are on order, and at the higher end the highly advanced MQ-28A uncrewed combat aerial vehicle (UCAV) is being developed.[27] The latter is a 'loyal wingman' concept that operates in a team with crewed combat aircraft and is likely to be the first of its kind to be operational globally.

The arms industry

Australia's arms industry consists of large foreign-owned companies, a few local medium-sized producers and over 3000 small businesses.[28] The industry focuses on marine and electronic systems.

Four of the top five Australian arms producers in 2020 were under foreign ownership or control (see table 3.2), which is partly the result of foreign purchases of Australia's key arms companies. For example, in 2006 Thales Group acquired Australian

[22] Brangwin, N., et al., 'Defending Australia: A history of Australia's defence white papers', Parliament of Australia, Parliamentary Library, Research Paper Series, 20 Aug. 2015.

[23] Australian Department of Defence, *2016 Defence White Paper* (Australian Government: Canberra, 2016); and Australian Department of Defence, *2020 Defence Strategic Update* (Australian Government: Canberra, 2020).

[24] Australian Department of Defence, *Defence Industrial Capability Plan* (Australian Government: Canberra, 2018).

[25] Australian Department of Defence, *Naval Shipbuilding Plan* (Australian Government: Canberra, 2017).

[26] Kadib, C., 'Osborne Shipyard SSN expansion plan unveiled', Defence Connect, 25 Mar. 2022; and Australian Department of Defence, 'Morrison government accelerates Sovereign Guided Weapons manufacturing', Media release, 31 Mar. 2021.

[27] Thales, 'Hawkei: The new generation protected tactical vehicle', [n.d.]; and Boeing, 'Boeing airpower teaming system', [n.d.].

[28] Australian Department of Defence, 'About the defence industry', [n.d.].

Table 3.1. Australia's domestic, licensed and imported arms as a proportion of total procurement of major conventional arms, 2016–20

	Procurement of major arms, 2016–20, volume (TIV millions)	Procurement of major arms, 2016–20, share of total volume (%)
Imports	7 085	*98.3*
Licensed	4 886	*67.8*
Domestic	121	*1.7*
Total	**7 205**	***100***

Table 3.2. Australia's largest arms-producing and military services companies, 2020

All sales figures are in millions of current (2020) US dollars.

Rank	Name	Arms sales, 2020	Total sales, 2020	Arms sales (%)	Main products	Ownership
1	Austal[a]	922	1 084	*85*	Ships, MRO	Publicly listed company
2	Thales Australia[b]	831	1 128	*74*	Avionics, electronics	Foreign subsidiary
3	BAE Systems Australia	810	853	*95*	Ships, aircraft MRO, C4ISR, armoured vehicles	Foreign subsidiary
4	Rheinmetall Defence Australia	463	463	*100*	Armoured vehicles	Foreign subsidiary
5	Boeing Defence Australia[b]	458	458	*100*	Aerospace	Foreign subsidiary

C4ISR = command, control, communications, computers, intelligence, surveillance and reconnaissance; MRO = maintenance, repair and overhaul.

[a] Austal generates 75 per cent of its revenue from its US subsidiary Austal USA.
[b] The arms sales figure for this company is an estimate with a high degree of uncertainty.

Defence Industries (ADI), previously one of the two biggest domestic arms companies.[29] In 2008 the other biggest native producer, Tenix Defence, was acquired by BAE Systems, which had gained ownership of AWA Defence Industries in 1996 and the shipbuilding business of ASC, one of Australia's biggest shipbuilders, in 2018.[30] Today, these multinational companies and a few Australian companies in the marine sector (Austal, ASC and Civmec) deliver most naval projects and subcontract to a large number of domestic small to medium-sized enterprises (SMEs).[31]

Uncrewed maritime vehicles

Australia's Future Maritime Operating Concept 2025 and the navy's RAS-AI Strategy 2040, both released after its 2020 Defence Strategic Update, lay out missions and goals for USVs and UUVs and suggest how AUVs and other UUVs could help counter military challenges in both surface and underwater domains.[32]

The Australian Department of Defence (DOD) has been contracting domestic entities such as Thales Australia to develop the Blue Sentry and Trusted Autonomous Systems (TAS) for the SeaWolf project, respectively (see table 3.3).[33] While Thales

[29] Ferguson, G., 'Defence business: Thales cleared to become the biggest Australian', *Australian Defence Magazine*, 1 Nov. 2006.

[30] BAE Systems Australia, 'Our history', [n.d.].

[31] Australian Government, *Defence National Manufacturing Priority Road Map* (Australian Government: Canberra, 2021).

[32] Australian Defence Force (ADF), *Future Maritime Operating Concept 2025: Maritime Force Projection and Control*, Unclassified version (ADF: Canberra, [n.d.]); Royal Australian Navy, *RAS-AI Strategy 2040* (Royal Australian Navy: Canberra, [n.d.]), p. 11; and Australian Department of Defence (note 23).

[33] Dominguez G., 'Australia selects Saab's AUV62-AT for ASW training', Janes, 7 Aug. 2020; and 'Thales and Flinders University sign MOU to automate launch and recovery system for Royal Australian Navy underwater vessels', 14. Sep. 2020.

Table 3.3. Australia's developments in uncrewed maritime systems

Programme name	Type	Status	Company	Origin	Points
Blue Sentry	USV	Under development	Thales Australia; Ocius	Domestic	1
XL-AUV	AUV	Under development	Anduril (USA)	Foreign	0
SeaWolf	UUV	Under development	Trusted Autonomous Systems (TAS) Cooperative Research Centre; Cellula Robotics	Domestic	1
AUV 62-AT	UUV	Procurement in progress	Saab (Sweden)	Foreign	0
SEA 1778 PH I	USV	Under development	Thales Australia	Domestic	1
New-Gen Hydroid Remus 100	UUV	In service	Kongsberg (Norway)	Foreign	0
BlueZone Group Z-Boats	USV	Under development	BlueZone Group	Domestic	1
Project P-17-246768 Theatre ASW-Off board DCL	USV	Under development	BlueZone Group; Boeing (Liquid Robotics) (USA)	Cooperation	0.5
Hydroid REMUS 600	AUV	In service	Hydroid (Norway)	Foreign	0
Total					**4.5**

ASW = anti-submarine warfare; AUV = autonomous underwater vehicle; USV = uncrewed surface vehicle; UUV = uncrewed underwater vehicle.

Australia is the prime contractor the Australian Navy's SEA 1778 programme to deliver the 9-inch and 12-inch diameter Bluefin UUVs, the AUV 62-AT is being developed by a Swedish branch of Saab, Saab Dynamics AB (not Saab Australia).[34] In early 2022 the DOD announced a new cooperation with US firm Anduril on an extra-large AUV (XL-AUV) project, estimated to cost 100 million Australian dollars (US$67 million).[35]

In addition, some domestic firms have built substantial ties with foreign suppliers to become their distributors or providers of maintenance, repair and overhaul (MRO) service in Australia. For example, in 2019 BlueZone Group was appointed by US company Marine Advanced Robotics as the exclusive distributor of WAM-V autonomous surface vehicles in Australia.[36]

[34] Lundquist, N., 'For the Royal Australian Navy, technological leap starts small', MarineLink, 25 June 2020; and Swedish Defence Materiel Administration (FMV), 'Komplext avtal för ubåtsjaktmål' [Complex agreement for submarine hunting targets], 25 Aug. 2020.

[35] Naval News, 'Anduril and Australian Navy to partner on XLUUV', 5 May 2022.

[36] Marine Technology News, 'New WAM-V distributor for Australia', 10 Apr. 2019.

4. China

China's arms industry has developed markedly since the 'Four modernizations' reforms of Deng Xiaoping in 1978, in particular since the United States and the European Union imposed arms embargoes following the massacre in Tiananmen Square in 1989. The introduction of a self-reliance objective can be traced back at least to the 10th five-year development plan, published in 2001, under the concept of 'conducting independent innovation' (自主创新, *zizhu chuangxin*).[37] One key driver behind the industry's rising technological capacity was the military–civil fusion policies pursued from the late 1990s, which have been further intensified by the current Chinese president, Xi Jinping.[38]

Arms procurement

Although China remained the world's fifth largest arms importer in 2016–20, the implementation of the self-reliance and military–civil fusion policies, combined with China's fast-paced economic growth, mean that the Chinese arms industry increasingly fulfils the requirements of the armed forces, the People's Liberation Army (PLA). Hence, while the volume of imports was still high in absolute terms, it accounted for only 8 per cent of total procurement for the period (see table 4.1). This is the lowest share for any of the 12 governments studied in this report. Deliveries of combat aircraft and air-defence systems from Russia were an important part of the imports (see table 4.2). However, these were all delivered by the end of 2019, and no new orders have since been announced. Imports of engines and helicopters continue, given China's difficulties in manufacturing its own designs.

Production under licence accounted for 79 per cent of imports (and 7 per cent of total acquisitions). This included helicopters from France and engines from France, Germany, Ukraine and the United Kingdom. However, the local content of the licence-produced major arms is high—probably close to 100 per cent.

Domestic production accounted for 92 per cent of total procurement. This share is likely to be an underestimate as data on Chinese procurements from domestic production is often unreliable or incomplete and estimates made for this report are conservatively low. Domestic production covers all categories of major arms, including almost all key components, and it includes the high end of technology (e.g. China is one of only two states that has a fifth-generation combat aircraft in serial production, and it is a pioneer in armed UAVs). While in recent years some significant but residual dependency on imports remained, mainly in engines and helicopters, it seems that China is also making rapid progress in those fields. Domestic production is replacing many of the types of major arms still imported in 2016–20. For instance, the latest versions of the J-10, J-11 and J-20 combat aircraft and the Y-20 transport aircraft, which started to be delivered in 2019 and 2020, use Chinese-designed engines instead of the imported Russian engines used in earlier versions.[39]

[37] Cheung, T. M., *Fortifying China: The Struggle to Build a Modern Defense Economy* (Cornell University Press: Ithaca, NY, 2009), p. 183; Cheung, T. M., *Innovate to Dominate: The Rise of the Chinese Techno-Security State* (Cornell University Press: Ithaca, NY, 2022), <https://muse.jhu.edu/book/97927>.

[38] Béraud-Sudreau, L. and Nouwens, M., 'Weighing giants: Taking stock of the expansion of China's defence industry', *Defence and Peace Economics*, vol. 32, no. 1 (2021).

[39] Rupprecht, A. and Giovanzanti, A., 'Chinese air force displays J-20A powered by domestic engines', Janes, 29 Sep. 2021; Giovanzanti, A., 'PLAAF 25th Air Brigade now operates J-10C multirole fighters', Janes, 23 Nov. 2021; Waldron, G., 'Domestic engines for Y-20 proceeding well', Flight Global, 30 Sep. 2021; Yeo, M., 'China fields J-10 jets powered by homemade engine', *Defense News*, 11 May 2021; and 'J-11B escorts H-6 bomber and proves Taihang engine's performance', China-Arms, 13 Feb. 2020.

Table 4.1. China's domestic, licensed and imported arms as a proportion of total procurement of major conventional arms, 2016–20

	Procurement of major arms, 2016–20, volume (TIV millions)	Procurement of major arms, 2016–20, share of total volume (%)
Imports	6 797	*8.4*
Licensed	5 391	*6.7*
Domestic	73 695	*91.6*
Total	**80 492**	***100***

Table 4.2. China's arms procurement by category of arms and type of procurement, 2016–20

Figures are the percentages of direct imports and licensed and domestic production for selected categories of major arms.

	Aircraft	Armour	Ships	Missiles	Air-defence systems
Imports	5.3	–	0.2	5.6	13.5
Licensed	0.5	–	0.2	0.3	0.7
Domestic	94.7	100	99.8	94.4	86.5

– = nil.

Table 4.3. China's largest arms-producing and military services companies, 2020

All sales figures are in millions of current (2020) US dollars.

Rank	Name	Arms sales, 2020	Total sales, 2020	Arms sales (%)	Main products	Ownership
1	China North Industries Group Corp. (Norinco)	17 926	70 997	*25*	Armoured vehicles, artillery, guided weapons, ammunition, air defence systems, small arms	State-owned
2	Aviation Industry Corp. of China (AVIC)	16 981	67 923	*25*	Aircraft and avionics	State-owned
3	China Aerospace Science and Technology Corp. (CASC)[a]	16 807	38 564	*44*	Missiles, space systems, UAVs	State-owned
4	China Electronics Technology Group Corp. (CETC)[a]	14 612	34 301	*43*	Military sonar, radar, electronic warfare systems, C4ISR systems	State-owned
5	China Aerospace Science and Industry Corp. (CASIC)[a]	11 871	37 686	*32*	Missiles and space systems	State-owned

C4ISR = command, control, communications, computers, intelligence, surveillance and reconnaissance; UAV = uncrewed aerial vehicle.

[a] The arms sales figure for this company is an estimate with a high degree of uncertainty.

The arms industry

China's arms industry primarily involves nine large state-owned enterprises (SOEs).[40] All eight companies with available data rank among the global Top 100 arm producers, with four in the top 10 in 2020.[41] Each of these firms dominates a specialized range of military products in its sector: four in aerospace and aviation, two in land systems, one in electronics, one in shipbuilding and one in nuclear power. The PLA is the main customer for the arms companies: the total value of arms sales of the top Chinese

[40] The Chinese government classifies the China Academy of Engineering Physics—a nuclear weapon research institute—as an arms industry corporation (军工集团, *jungong jituan*), but it is not an arms company according to SIPRI's definition.

[41] The methodology for ranking Chinese arms companies was developed in Tian, N. and Su, F., 'Estimating the arms sales of Chinese companies', SIPRI Insights on Peace and Security no. 2020/2, Jan. 2020. The ranking here may differ from those published in any earlier SIPRI publications owing to continual revision and updates of data, often because of changes reported by the company itself and sometimes because of improved estimations.

companies is similar to Chinese military equipment spending according to SIPRI estimates, an indication of a relatively high level of self-reliance in arms production.[42]

Driven by the Chinese government's continued military modernization goals and military–civil fusion policies, the SOEs are increasingly involved in emerging technologies while also boosting their sales of civilian products and services.[43] Today all major Chinese arms companies derive most of their revenue from a myriad of non-military activities, ranging from civilian industrial goods to financial services, real estate and energy. In 2020 military sales accounted for only 31 per cent of the total revenue of the top five arms producers (see table 4.3).

Signs of a new wave of consolidation have been observed in recent years in a bid to raise efficiency in domestic production and join forces in foreign markets.[44] The Aviation Industry Corporation of China (AVIC) merged its two aircraft engine businesses in 2016 and is planning to combine two of its avionics subsidiaries in 2022. In 2018 the main nuclear engineering contractor, China Nuclear Engineering and Construction Group (CNEC), merged into the nuclear power and fuel provider China National Nuclear Corporation (CNCC). The two largest shipbuilders merged back into a single shipbuilding company, China State Shipbuilding Corporation (CSSC), in 2019. This reversed a previous structural reform to improve productivity and competitiveness by breaking up sector monopolies.[45]

Uncrewed maritime vehicles

China's 2019 National Defence White Paper recognizes the trend for conflict to evolve 'towards informationized warfare, and intelligent warfare', with a consequent 'prevailing trend to develop long-range precision, intelligent, stealthy or unmanned weaponry and equipment'.[46] China has long engaged in R&D on naval autonomous programmes. The earliest programme can be traced back to 1995 with a joint development programme for the CR-01 AUV between Russia's Institute of Marine Technology Problems and the Shenyang Institute of Automation of the Chinese Academy of Sciences.[47] An unnamed UUV programme with autonomous target-detection and fire capabilities developed by Harbin Engineering University was declassified in 2021 but was reportedly already tested in 2010.[48]

By 2021, more than 40 universities, research institutes and companies were reported to have hosted up to 159 UUV projects (see table 4.4 for the main military USV and UUV projects that could be identified in open sources).[49] China's portfolio ranges from the JARI multipurpose assault USV to a multi-mission reconfigurable AUV developed by the China Academy of Aerospace Aerodynamics.[50]

[42] Tian and Su (note 41).

[43] Marksteiner, A. et al., 'The SIPRI Top 100 arms-producing and military services companies, 2020', SIPRI Fact Sheet, Dec. 2021.

[44] Xinhua News Agency, [CSSC accelerates consolidation of subsidiaries], Dec. 2021 (in Chinese).

[45] Medeiros, E. S. et al., *A New Direction for China's Defense Industry* (RAND Corp.: Santa Monica, CA, 2005), p. xix.

[46] Chinese State Council, *China's National Defense in the New Era* (State Council Information Office: Beijing, 2019), chapter I. See also Kania, E. B., 'AI weapons in China's military innovation', Brookings, Apr. 2020.

[47] Submarines on Stamps, 'CR-01, AUV—autonomous unmanned underwater vehicle', [n.d.].

[48] Crumley, B., 'China develops a fully autonomous underwater attack drone', Drone DJ, 13 July 2021; and Chen, S., 'China reveals secret programme of unmanned drone submarines dating back to 1990s', *South China Morning Post*, 8 July 2021.

[49] Fedasiuk, R, 'How China is militarizing autonomous underwater vehicle technology', Maritime Executive, 22 Aug. 2021.

[50] Sina News, [Sina published information on JARI multi-purpose assault USV], 25 Aug. 2019 (in Chinese); Huanqiu, [Huanqiu reported on Haidou-1], 10 Oct. 2021 (in Chinese); and Wong, K., 'Airshow China 2021: CASC unveils airdrop AUV concept', Janes, 30 Sep. 2021.

Table 4.4. China's developments in uncrewed maritime systems

Programme name	Type	Status	Company	Origin	Points
Multi-mission reconfigurable AUV	AUV	Under development	China Academy of Aerospace Aerodynamics	Domestic	1
Unnamed (ASW mission)	UUV	. . (tested in 2010)	Harbin Engineering University	Domestic	1
Lanxin	USV	Under development	Dalian Maritime University	Domestic	1
Haiyan-X	AUV	Under development	Tianjin University	Domestic	1
Glider Haiyi 1000	AUV	In service	Shenyang Institute of Automation; Deepfar Ocean Technologies	Domestic	2
Unnamed	USV	Under development	Sino Polymer; Hybrid Shipbuilding company (Russia); Kvand (Belarus)	Cooperation	0.5
JARI	USV	Under development (sea trials)	CSSC (716th Research Institute; 702nd Research Institute)	Domestic	1
HSU-001	UUV	Reported in service	Reported to be Shenyang Institute of Automation	Domestic	1.5[a]
XG-2	USV	. .	CASIC	Domestic	1
Qianlong III	AUV	Under development	Shenyang Institute of Automation	Domestic	1
UCSV (300–340 tonnes, trimaran hull)	USV	Under development	CSSC (716th Research Institute; Huangpu Shipyard 427 Factory); AVIC (605th Research Institute)	Domestic	1
Unnamed (100 tonnes, trimaran)	USV	Under development	Zhejiang Beikun Intelligent Technology; Tongfang Jiangxin Shipbuilding	Domestic	1
D3000 Oceanic Combat Vessel	USV	. . (concept stage)	CASC	Domestic	1
Haijing 2000	AUV	Under development	Shenyang Institute of Automation	Domestic	1
L30	USV	Under development	YunZhou Tech	Domestic	1
Zhuhai Yun	USV	Under development	China Ship Design & Research Center (CSSC)	Domestic	1
Marine Lizard (Amphibious USV)	USV	Under development	Wuchang Shipbuilding Industry Group (CSSC)	Domestic	1
Total					**18**

. . = not known/no data available; ASW = anti-submarine warfare; AUV = autonomous underwater vehicle; CASC = China Aerospace Science and Technology Corporation; CASIC = China Aerospace Science and Industry Corporation; CSSC = China State Shipbuilding Corporation; UCSV = uncrewed combat surface vehicle; USV = uncrewed surface vehicle; UUV = uncrewed underwater vehicle.

[a] Because of the uncertainty as to whether the HSU-001 is already in service, the programme is attributed 1 point for domestic design, but only 0.5 points for operational status.

5. India

India has built up a substantial arms industry since the 1950s, supported by successive policy plans to cultivate a domestic arms industry capable of developing its own designs.[51] The current arms industrial policy is included in the broader 'Make in India' policy that promotes local production in partnerships with foreign companies.[52] These priorities are also clearly reflected in budgetary allocations: in its 2021 military expenditure, India earmarked 64 per cent of its capital outlays for domestic equipment acquisitions.[53] In order to foster the development of local products, between 2020 and 2022 the Indian government issued three lists of military products subject to an import ban, totalling over 300 goods.[54]

Arms procurement

Despite the long-term efforts, India remains one of the largest importers of major arms globally: for the period 2016–20, it ranked as the second largest importer. India is highly dependent on imports of complete foreign major arms, including many produced under licence or as components for its domestic production. Of India's total volume of procurement in 2016–20, 84 per cent was of foreign origin (see table 5.1).

Licensed production accounted for 69 per cent of the imports (58 per cent of total acquisitions). Much of the licensed production has a substantial Indian content and includes some use of Indian-designed components to replace original foreign components, as in the Su-30MKI combat aircraft imported from Russia.[55] An important objective of licensed production is to gain capabilities to develop local design through technology transfers. However, over the decades this has not often been successful—for example, the technology transfer related to the recently completed large programme for the Russian Su-30MKI was reportedly seen in India as a 'mistake' since no real technology transfer took place.[56]

Domestic production accounted for 16 per cent of total procurement. Land-attack missiles (including for use with nuclear warheads) and the *Arihant* (a class of nuclear-powered ballistic missile submarines) are domestic designs that give India's nuclear forces a high level of autonomy.[57] Most of the surface ships delivered in 2016–20 were also Indian designs (see table 5.2). However, in recent decades domestic development has been slow and often not very successful in other categories of major arms.[58] For example, the Tejas combat aircraft, which started development in the 1980s, is still not fully operational, and only 124 of the equally delayed Arjun tank were acquired before it was decided to continue to buy Russian T-90S tanks. In addition, domestic designs remain dependent on imported key component such as engines and radars.

[51] Weiss, M., 'State vs. market in India: How (not) to integrate foreign contractors in the domestic defense-industrial sector', *Comparative Strategy*, vol. 37, no. 4 (2018).

[52] Make in India, 'About us', India Department for Promotion of Industry and Internal Trade, [n.d.].

[53] Indian Ministry of Defence, 'Union Budget 2022–23', Indian Government Press Information Bureau, 1 Feb. 2022.

[54] Press Trust of India, 'Rajnath releases 3rd list of weaponry to be banned for import to boost self-reliance in defence manufacturing', *Times of India*, 7 Apr. 2022; and 'India to ban import of 100 more weapons', *Hindustan Times*, 7 Apr. 2022.

[55] Janes, 'Su-30MKI equipment profile', June 2020.

[56] Pandit, R., 'To avoid Sukhoi "mistake", India to go for Russian 5th-generation fighter only on complete-tech transfer pact', *Economic Times* (Mumbai), 11 July 2018.

[57] Kristensen, H. M. and Korda, M., 'Indian nuclear forces', *SIPRI Yearbook 2022: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2022).

[58] Press Trust of India, 'Parliamentary panel criticises long delay in implementation of Tejas programme', *Economic Times* (Mumbai), 3 Feb. 2021; and Shukla, A., 'Arjun tank outruns, outguns Russian T-90', *Business Standard* (New Delhi), 20 Jan. 2013.

Table 5.1. India's domestic, licensed and imported arms as a proportion of total procurement of major conventional arms, 2016–20

	Procurement of major arms, 2016–20, volume (TIV millions)	Procurement of major arms, 2016–20, share of total volume (%)
Imports	15 067	*84.3*
Licensed	10 328	*57.8*
Domestic	2 815	*15.7*
Total	**17 883**	***100***

Table 5.2. India's arms procurement by category of arms and type of procurement, 2016–20

Figures are the percentages of direct imports and licensed and domestic production for selected categories of major arms.

	Aircraft	Armour	Ships	Missiles	Air-defence systems
Imports	93.7	100	21.4	92.3	60.6
Licensed	75.0	100	21.4	57.5	60.6
Domestic	6.3	–	78.6	7.7	29.4

– = nil.

Despite these setbacks, India has ambitious programmes for additional nuclear-powered submarines, new combat aircraft designs, autonomous weapons (e.g. a loyal wingman UCAV and autonomous reconnaissance vehicles) and associated components.[59] The earlier experiences of Indian domestic arms programmes leave serious doubts about whether India will be able to significantly reduce its dependence on imports in the short or medium terms.

The arms industry

India's domestic arms production has long been dominated by several SOEs (known as Defence Public Sector Undertakings, DPSUs) and by Indian Ordnance Factories, the production units under the Ministry of Defence (MOD). Four of India's five largest arms producers are the respective leading producers in aerospace, land systems, electronics and shipbuilding (see table 5.3). The fifth biggest company, Cochin Shipyard, is producing India's first indigenous aircraft carrier.

Despite their size and industry dominance, there are lingering concerns over the DPSU's productivity, their reliance on domestic military orders and their dependence on foreign resources.[60] Against this background, Indian state-owned companies have started to diversify their business into the civil market and to set up export offices overseas.[61] In an effort to improve autonomy and efficiency in ordnance production, in October 2021 the Indian government dissolved Indian Ordnance Factories and reformed its 41 units into 7 DPSUs.[62]

The Make in India policy further supports an emergent private sector, with over 200 companies licensed to produce military items and bid for government projects, often in collaboration with major foreign arms producers.[63] Ashok-Leyland, the only Indian private sector company ranked among the top 50 in the Indo-Pacific (see table 15.2), is

[59] Kadidal, A., 'HAL's loyal wingman programme on schedule to go airborne by 2024', *Jane's Defence Weekly*, 6 Apr. 2022, p. 14.

[60] Das, S. P., 'An overview of Indian defence industry: A transformative perspective', *CLAWS Journal*, vol. 12, no. 1 (summer 2019); and Chengappa, B., 'India's defence industry lack fire power', Hindu Business Line, 14 Feb. 2018.

[61] Hindustan Aeronautics Ltd (HAL), *58th Annual Report 2020–21* (HAL: Bengaluru, Oct. 2021); and Indian Ministry of Defence (MOD), *Annual Report Year 2018–2019* (MOD: New Delhi, [2019]).

[62] Since this report focuses on data for 2020, Indian Ordnance Factories is still listed as one company in table 5.3. On the reform see Indian Ministry of Defence, Directorate of Ordnance (Coordination and Services), 'History—Corporatisation of Indian Ordnance Factories', 6 June 2022.

[63] Indian Ministry of Defence, 'Reforms in defence sector: Propelling private sector participation (2014–2021)', Indian Government Press Information Bureau, 16 Dec. 2021.

Table 5.3. India's largest arms-producing and military services companies, 2020

All sales figures are in millions of current (2020) US dollars.

Rank	Name	Arms sales, 2020	Total sales, 2020	Arms sales (%)	Main products	Ownership
1	Hindustan Aeronautics	2 968	3 124	*95*	Aircraft, avionics	State-owned
2	Indian Ordnance Factories[a]	1 897	1 935	*98*	SALW, ammunition, artillery, armoured vehicles	State-owned
3	Bharat Electronics	1 483	1 901	*78*	Avionics	State-owned
4	Mazagon Dock	547	547	*100*	Ships	State-owned
5	Cochin Shipyard	326	381	*86*	Ships	State-owned

SALW = small arms and light weapons.

Table 5.4. India's developments in uncrewed maritime systems

Programme name	Type	Status	Company	Origin	Points
Unnamed	AUV	Under development	CMERI	Domestic	1
Unnamed	UUV	Under development	Hindustan Shipyard	Domestic	1
Amogh	AUV	Under development	L&T; EdgeLab (Italy)	Cooperation	0.5
Adamya	AUV	Under development	L&T	Domestic	1
Maya	AUV	Under development	National Institute of Oceanography	Domestic	1
Hugin	AUV	Procurement in progress	Kongsberg (Norway)	Foreign	0
Matsya	AUV	Under Development	IIT Bombay	Domestic[a]	1
Total					**5.5**

AUV = autonomous underwater vehicle; CMERI = Central Mechanical Engineering Research Institute; IIT = Indian Institute of Technology; L&T = Larsen & Toubro; UUV = uncrewed underwater vehicle.

[a] Teledyne Technologies (USA) is a parts supplier and sponsor for the Matsya AUV but is probably not involved as a design or development partner.

one of the largest suppliers of military trucks to the Indian Army.[64] India's other private arms manufacturers (e.g. Larsen & Toubro and Reliance) feature neither in the country's top 5 nor the regional top 50.

Uncrewed maritime vehicles

To support the implementation of artificial intelligence (AI) projects with military applications, in 2019 India established the high-level Defence AI Council (DAIC) and the Defence AI Project Agency (DAIPA).[65] Such projects are expected to include USVs and UUVs.[66] The Indian Naval Indigenisation Plan 2015–30 further acknowledges UUVs as a critical capability for future warfare and the country's need to import remotely operated vehicles and AUVs for the shipbuilding programme.[67]

The Defence Research and Development Organisation (DRDO) and the Central Mechanical Engineering Research Institute (CMERI) have been considering development of AUV prototypes (see table 5.4).[68] In the private sector, Larsen & Turbo has been developing AUV prototypes on its own and in collaboration with foreign partners, such as Italy's EdgeLab.[69]

[64] Ashok Leyland, 'Ashok Leyland and the Indian Armed Forces', [n.d.].

[65] Indian Ministry of Defence, Department of Defence Production, 'Implementation of the recommendations of the multi-stakeholder task force constituted by the Ministry of Defence for "Strategic Implementation of Artificial Intelligence for National Security and Defence"', File no. 8(19)/2018-D(Coord/DDP), 8 Feb. 2019.

[66] Indian Ministry of Defence (note 61), pp. 62–63.

[67] Indian Navy, Directorate of Indigenisation, *Indian Naval Indigenisation Plan (INIP) 2015–2030* (Indian Navy: New Delhi, 2015), p. 5.

[68] Kumar, N., 'India's CMERI highlights domestic underwater vehicle development', Janes, 1 Sep. 2020.

[69] EdgeLab, 'Amogh: the dependable autonomous underwater vehicle', [n.d.].

6. Indonesia

Indonesia's drive for the development of a domestic arms industry, present since the 1990s, has accelerated in recent years.[70] It established a Defence Industry Policy Committee in 2010, tasked with coordinating the development of the domestic arms industry.[71] This was followed by a defence offset policy in 2012, with the goal of stimulating technology transfers in support of the domestic arms industry.[72] At the time, 2029 was indicated as the target to reach full self-sufficiency, but this ambition is far from being attained.[73] The omnibus Law on Job Creation of 2020 updated the 2012 regulation, with the added ambition of increasing private sector involvement in arms production.[74] Under the 2020–24 Defence Industrial Development Plan, the government expects the Indonesian armed forces to prioritize domestic acquisitions over imports.[75]

Arms procurement

Indonesia remains to a large extent reliant on foreign suppliers. It was the world's 17th largest importer of major arms over the period 2016–20, when imports accounted for 90 per cent of its arms acquisitions (see table 6.1). Production under licence accounted for 36 per cent of the imports (32 per cent of total procurement).

Local involvement in imported arms varies. In the case of the three Type-209 submarines ordered from South Korea, only the third is being partly produced in Indonesia. Local input in the production of AS-332 helicopters from France accounts for little more than assembly of imported kits. In contrast, the LPD-122m landing ships from South Korea are largely produced locally—Indonesia even has the export rights for the design and has sold several abroad. Similarly, C-212 transport aircraft originally licensed from Spain are produced locally, and Indonesia has export rights.

Domestic production accounted for only 10 per cent of total procurement. An important part of this is the CN-235 transport aircraft, developed in cooperation with Spain. Production of truly domestic designs is limited to smaller ships, light armoured vehicles and light UAVs. None of these are technically advanced, and all use key imported components—engines, sensors and armament. Plans to develop larger and more advanced major arms—such as combat aircraft and light tanks—are progressing at a slow pace and as a junior partner with foreign suppliers.[76]

The arms industry

Indonesia's arms industrial base is dominated by five specialized state-owned companies (see table 6.2), with small private sector firms as subcontractors. These five producers are modest in size, and their level of self-reliance is also limited due to their dependence on foreign technologies.

[70] S. Rajaratnam School of International Studies (RSIS), Indonesia Programme, 'Indonesia's emerging defence economy: The Defence Industry Law and its implications', RSIS Policy Report, 12 Aug. 2013, p. 2.

[71] Haripin, M., 'Rearming the Indonesian state: The role of Defence Industry Policy Committee', *Ritsumeikan Journal of International Relations and Area Studies*, vol. 44, no. 12 (2016).

[72] Law of the Republic of Indonesia no. 16 of 2012, 'Tentang Industri Pertahanan' [On the defence industry], 5 Oct. 2012.

[73] Safitri, D., 'Mempertahankan industri pertahanan' [Defending the defence industry], BBC Indonesia, 14 June 2013.

[74] Fitri, A., 'Involvement of private party in national defense industry in Omnibus Law', *Info Singkat*, vol. 12, no. 20 (Oct. 2020).

[75] Grevatt, J., 'Indonesia outlines defence industrial priorities for 2020–24', *Jane's Defence Weekly*, 23 July 2019.

[76] Oryx, 'Ride the Turkish tiger: Indonesia's Kaplan MT tanks', 7 Jan. 2022; and Choi, S., 'S. Korea, Indonesia finalize fighter jet costs amid default rumors', *Korea Herald*, 11 Nov. 2021.

Table 6.1. Indonesia's domestic, licensed and imported arms as a proportion of total procurement of major conventional arms, 2016–20

	Procurement of major arms, 2016–20, volume (TIV millions)	Procurement of major arms, 2016–20, share of total volume (%)
Imports	2 368	*90.2*
Licensed	851	*32.4*
Domestic	258	*9.8*
Total	**2 625**	***100***

Table 6.2. Indonesia's largest arms-producing and military services companies, 2020
All sales figures are in millions of current (2020) US dollars.

Rank	Name	Arms sales, 2020	Total sales, 2020	Arms sales (%)	Main products	Ownership
1	PT Pindad	157	240	*65*	Armoured vehicles, ammunition	State-owned
2	PT Dirgantara Indonesia[a]	105	159	*66*	Aircraft, MRO	State-owned
3	PT PAL	72	125	*58*	Ships, MRO	State-owned
4	PT Len Industri[a]	46	288	*16*	Military electronics and communications	State-owned
5	PT Dahana[a]	18	112	*16*	Explosives, propellants	State-owned

MRO = maintenance, repair and overhaul.

[a] The arms sales figure for this company is an estimate with a high degree of uncertainty.

The shipbuilding sector is Indonesia's strongest. PT PAL develops patrol vessels and missile boats (albeit with foreign input on systems and components) and produces submarines under licence from Daewoo Shipbuilding & Marine Engineering (DSME) of South Korea.[77] It is also the sector where private firms are most present, with shipbuilders such as PT Palindo and PT Lundin competing with PT PAL for government orders.

The other sectors have a narrower domestic capacity and depend even more heavily on foreign input. PT Pindad, a land systems manufacturer, is Indonesian's biggest arms company. It can produce armoured vehicles and ammunition but relies on foreign support for more complex systems.[78] PT Dirgantara Indonesia (PTDI), an aerospace company, has co-developed transport aircraft with Airbus, a European company, and is developing UAV capacities in collaboration with a military electronics manufacturer, PT Len Industri. However, it still earns most of its arms revenue from the licensed production of foreign-designed aircraft and MRO activities.

To consolidate strengths and build self-reliance, a state-owned arms industry holding company, Defence Industry Indonesia (Defend ID), was established in April 2022 combining the top 5 companies.[79] The impact of this merger on the industry structure and capabilities remains to be observed in the coming years.

Uncrewed maritime vehicles

Only limited information on Indonesia's interest in naval autonomous technologies or systems is available in official documents: there is no reference in the 2015 Defence White Paper or in the 2012 Minimum Essential Force Procurement Programme.[80] Furthermore, the Indonesian Navy's procurement plans do not refer to autonomous

[77] PT PAL, 'The Alugoro-405 submarine has officially handed over from the shipyard to the Ministry of the Defense Republic of Indonesia', Press release, 17 Mar. 2021.

[78] Antara News, 'Indonesia's Pindad develops combat vehicle with Belgian company', 5 Sep. 2014.

[79] Indonesian Cabinet Secretariat, 'Gov't launches state-owned defense industry holding Defend ID', 20 Apr. 2022.

[80] Indonesian Ministry of Defence (MOD), *Defence White Paper* (MOD: Jakarta, Nov. 2015); and Indonesian Ministry of Defence, 'Penyelarasan *minimum essential force* komponen utama' [Minimum essential force alignment policy], Appendix to Regulation no. 19, June 2012.

Table 6.3. Indonesia's developments in uncrewed maritime systems

Programme name	Type	Status	Company	Origin	Points
Hugin	AUV	In service	Kongsberg (Norway)	Foreign	0
Total					0

AUV = autonomous underwater vehicle.

systems.[81] Nonetheless, Indonesia has procured two Hugin AUV systems from the Norwegian firm Kongsberg (see table 6.3).[82] Indonesia's PT Lundin developed the Bonefish USV programme in cooperation with Saab of Sweden, but the programme was officially transferred to the latter in 2015. Saab has since ceased to market Bonefish, and there is no indication that PT Lundin pursued the programme.[83]

[81] President of Indonesia, 'Kebijakan umum pertahanan negara tahun 2020–2024' [General national defence policy 2020–2024], Regulation no. 8 of 2021. See also Grevatt, J., 'Indonesia outlines 2020–24 military procurement priorities', *Jane's Defence Weekly*, 10 Dec. 2019.

[82] Kongsberg, 'Kongsberg maritime delivers training on Hugin AUV systems', 29 Apr. 2016.

[83] Wong, K., 'Bonefish evolved: Saab's USV development programme transcends trimaran demonstrator', *Jane's International Defence Review*, 22 Dec. 2015; and Arthur, G., 'Saab Bonefish proceeds apace', Shephard, 9 Oct. 2015.

7. Japan

Japan has a large and advanced arms industry that in the post-World War II era has produced all categories of major arms. The goal of domestic arms production was pursued by incentivizing large civilian conglomerates to enter military production.[84] Contractors for the Japanese Defense Agency (the Ministry of Defense from 2007) were shielded from foreign competition through direct contract allocations. In 2014 Japan took new steps to strengthen its domestic arms-production sector, most notably by lifting its self-imposed ban on exports.[85] One of the announced goals of this historical move was to foster the competitiveness of its domestic arms-manufacturing firms.[86]

Arms procurement

Japan was the 12th largest importer of major arms globally in the period 2016–20. Yet it has a high level of domestic design and production: 74 per cent of its total procurement of major arms (see table 7.1). Domestic production covered all categories of major arms and accounted for most or all acquisitions of most of these (see table 7.2). Domestic designs are highly advanced, on a par with the best that other major producers have to offer.

Imports accounted for the remaining 26 per cent of procurement. Of the imports, 62 per cent was licensed production (16 per cent of total procurement), which often involved a high level of input from the Japanese industry.

Currently, the main type of major arms not produced locally is combat aircraft. Japan has produced advanced combat aircraft and did consider developing its own fifth-generation combat aircraft, but instead choose to buy the F-35 from the USA. However, it has an ongoing development programme for a sixth-generation combat aircraft (Mitsubishi F-X). While the F-X was initially a domestic project, Japan and the United Kingdom are reportedly seeking to merge their respective combat aircraft programmes.[87]

The arms industry

Japan's long-established arms industry is, like that of South Korea, composed mainly of large conglomerates that are also active in the civilian commercial sector. Japan's arms industry is dominated by an oligopoly of a few industrial conglomerates that predominantly produce civilian products and derive only a small share of their revenue from arms production. For example, only 13 per cent of total sales by Mitsubishi Heavy Industries come from arms sales (see table 7.3) despite it being Japan's largest arms producer for much of the past two decades and taking about 25 per cent of MOD contracts.[88] This is partly due to Japan's low level of military spending under its pacifist constitution and the pre-2014 self-imposed arms export ban. The result

[84] Hugues, C. W., 'Japan's defence industry: From indigenisation to exploring internationalisation', eds K. Hartley and J. Belin, *The Economics of the Global Defence Industry* (Routledge: Abingdon, 2019), pp. 401, 424.

[85] Japanese Ministry of Foreign Affairs, 'Japan's policies on the control of arms exports', [n.d.]; and Japanese Ministry of Foreign Affairs, 'The three principles on transfer of defense equipment and technology', 6 Apr. 2016.

[86] Sakaki, A. and Maslow, S., 'Japan's new arms export policies: Strategic aspirations and domestic constraints', *Australian Journal of International Affairs*, vol. 74, no. 6 (June 2020); and Bergenwall, S., Korkmaz, K. and Rydqvist, J., *Japan's Defence and Security Policy: A Primer*, FOI-R-4249-SE (Swedish Defence Research Agency (FOI): Stockholm, Mar. 2016), pp. 26–27.

[87] Japanese Ministry of Defense, 'Launch of the F-X development program and the direction of international collaboration', *Japan Defense Focus*, no. 133 (Mar. 2021); and Kelly, T. et al., 'Britain and Japan aim to merge Tempest and F-X fighter programmes—sources', Reuters, 14 July 2022.

[88] Hugues (note 84).

Table 7.1. Japan's domestic, licensed and imported arms as a proportion of total procurement of major conventional arms, 2016–20

	Procurement of major arms, 2016–20, volume (TIV millions)	Procurement of major arms, 2016–20, share of total volume (%)
Imports	3 036	*26.2*
Licensed	1 887	*16.3*
Domestic	8 550	*73.8*
Total	**11 586**	***100***

Table 7.2. Japan's arms procurement by category of arms and type, 2016–20

Figures are the percentages of direct imports and licensed and domestic production for selected categories of major arms.

	Aircraft	Armour	Ships	Missiles	Air-defence systems
Imports	36.4	12.9	–	30.5	–
Licensed	23.8	12.9	–	9.1	–
Domestic	63.6	87.1	100	69.5	–

– = nil.

Table 7.3. Japan's largest arms-producing and military services companies, 2020

All sales figures are in millions of current (2020) US dollars.

Rank	Name	Arms sales, 2020	Total sales, 2020	Arms sales (%)	Main products	Ownership
1	Mitsubishi Heavy Industries (MHI)	4 421	34 657	*13*	Aircraft, electronics, ships, missiles, engines	Publicly listed company
2	Kawasaki Heavy Industries (KHI)	2 444	13 943	*18*	Aircraft, ships	Publicly listed company
3	Fujitsu	1 322	33 625	*4*	Electronics	Publicly listed company
4	IHI Corp.	1 042	10 425	*10*	Aircraft, ships, engines	Publicly listed company
5	Mitsubishi Electric Corp.	917	39 261	*2*	Radar, space systems	Publicly listed company

Note: Data on Japanese companies was provided by the Mitsubishi Research Institute.

has been expensive production, low profitability and low competitiveness in the international market.[89]

Supported by Japan's particularly advanced and diversified manufacturing industry, arms companies in all sectors are highly capable in their domestic production of complex arms systems. MHI and Kawasaki Heavy Industries (KHI) are the leading producers in all domains. Other Japanese companies in the regional top 50, such as Fujitsu, NEC Corporation and Subaru, specialize in electronics, marine and land systems. In contrast, the military aerospace businesses of MHI and KHI involve more licensed production and depend far more on US technologies, such as Boeing's F-15 and Lockheed Martin's F-35, among other aircraft.

Uncrewed maritime vehicles

The Japanese MOD's 2019 R&D Vision dedicates a full chapter to underwater warfare technologies, listing specific autonomous capabilities that it seeks to acquire.[90] The 2022 Defence White Paper also lists the acquisition of UUV as a priority among the

[89] Japanese Ministry of Defense (MOD), *Strategy on Defense Production and Technological Bases: Toward Strengthening the Bases to Support Defense Forces and 'Proactive Contribution to Peace'* (MOD: Tokyo, June 2014); and Kobara, J., Ochi, K. and Kawasaki, N. 'Japan's defense industry on the ropes amid growing threats', Asia Nikkei, 12 Jan. 2022.

[90] Japanese Ministry of Defense (MOD), *R&D Vision: Toward Realization of Multi-Domain Defense Force and Beyond* (MOD: Tokyo, 2019), pp. 13–14.

Table 7.4. Japan's developments in uncrewed maritime systems

Programme name	Type	Status	Company	Origin	Points
AI-based naval integrated system	USV	Under development	Unspecified company, Japan Coast Guard	Domestic	1
OZZ-5	UUV	Under development	Mitsubishi, Thales (France)	Cooperation	0.5
Assault UUV prototypes (mining mission)	UUV	Under development	MOD	Domestic	1
Joint Technological Development Programme for the Demonstration of Unmanned Ships	UUV/ USV	Under development	Nippon Foundation, Marubeni Corporation, Mitsui E&S Shipbuilding	Domestic	1
UUV simulation system	UUV	Under development	MOD, ATLA, Mitsubishi	Domestic	1
Unnamed large (10 m)	UUV	Under development	Naval Systems Research Center (ATLA)	Domestic	1
Aquarius USV	USV	Under development	Echo Marine Power	Domestic	1
FFM USV	USV	Under development	Japan Marine United (JMU) Defense Systems	Domestic	1
Total					**7.5**

AI = artificial intelligence; ATLA = Acquisition, Technology and Logistics Agency; MOD = Ministry of Defense; USV = uncrewed surface vehicle; UUV = uncrewed underwater vehicle.

capabilities that should be acquired and strengthened.[91] It also identifies the use of AI in the development of future USVs and UUVs as an objective.

Japanese government agencies and companies thus work on a relatively high number of USV and UUV projects (see table 7.4). On the government side, the Japan Agency for Marine-Earth Science and Technology has been developing and operating uncrewed research vessels for decades. The MOD's Naval Systems Research Center, under the Acquisition, Technology and Logistics Agency (ATLA), also conducts extensive research in this field.[92] In the private sector, three shipbuilding companies (Marubeni Corporation, Tryangle and Mitsui E&S Shipbuilding) have formed a consortium to develop 'autonomous ship technology'.[93] Japanese efforts seem to have paid off in recent years, resulting in two prototypes of small UUVs acting as self-propelled mine systems (in 2020), a simulation system for UUVs (in 2020) and a prototype of the OZZ-5 UUV (2021), among others.[94]

[91] Japan Ministry of Defense (MOD), *Defense of Japan 2022* (MOD: Tokyo, 2022), pp. 236, 486.

[92] Japan Ministry of Defense, Acquisition, Technology and Logistics Agency (ATLA), *Naval Systems Research Center* (ATLA: Tokyo, 2021).

[93] Ship Technology, 'Japanese consortium to develop autonomous ship technology', 15 June 2020.

[94] Takahashi, K., 'Japan aiming to develop prototypes of self-propelled mine system', *Jane's Defence Weekly*, 23 June 2020; Inaba, Y., 'New USV for Japan's Mogami-class FFM frigate breaks cover', Naval News, 31 Aug. 2021; and Vavasseur, X., 'Thales to deliver SAMDIS sonar for JMSDF's OZZ-5 UUV', Naval News, 24 Nov. 2020.

8. South Korea

South Korea's arms industrial policy originated in the perceived need to lower its dependence on US weapon systems, as early as the 1970s.[95] The Defense Reform 2020 plan of 2005 accelerated this process.[96] Another milestone in South Korea's domestic arms industrial policy was the creation in 2006 of the Defense Acquisition Program Administration (DAPA). DAPA is responsible for procurement, development of the arms industry and arms exports.[97] Another acceleration to the self-reliance policy occurred after 2015, following a denial by the United States of technology transfers in the framework of the F-35 combat aircraft programme.[98] New legislation was introduced in 2021 to stimulate the procurement of domestic military products, with the reported aim of spending 80 per cent of the procurement budget on domestic purchases.[99]

Arms procurement

Based on SIPRI's methodology, South Korea has not yet reached the 80 per cent goal. South Korea was still the seventh largest importer of major arms globally over the period 2016–20, and imports remained the country's main source of acquisitions, accounting for 56 per cent of the total volume (see table 8.1). Most of the large imports are arms at the high end of technology: F-35 combat aircraft, AH-64 combat helicopters, Patriot air-defence systems and various types of engine for aircraft, ships and land systems.

Production under licence accounted for 35 per cent of imports (and 20 per cent of total procurement). This included submarines from Germany and combat helicopters from the USA. Both included technology transfers, which played a role in developing South Korea's capabilities to produce similar platforms.[100]

Domestic production accounted for 44 per cent of acquisitions of major arms in 2016–20. Domestic production covers all categories of major arms (see table 8.2), including many key components, even if in some cases the arms are at a lower end of technology (e.g. TA-50 trainer/light combat aircraft). Some key subsystems still rely on foreign transfers: for instance, the combat system of the KDX-III destroyer is the US Aegis.[101] However, other domestic major arms have reached high levels of technology, and South Korea was the world's eighth largest arms exporter in 2016–20.[102]

South Korea's high level of ambition to further develop domestic capabilities is indicated by active programmes to develop advanced combat aircraft and an aircraft carrier, and a plan for nuclear-powered submarines.[103]

[95] Jong, C. C., 'South Korea', ed. R. P. Singh, SIPRI, *Arms Procurement Decision Making*, vol. I, *China, India, Israel, Japan, South Korea and Thailand* (Oxford University Press: Oxford, 1998), p. 194.

[96] Korkmaz, K. and Rydqvist, J., *The Republic of Korea: A Defence and Security Primer*, FOI-R-3427-SE (Swedish Defence Research Agency (FOI): Stockholm, Apr. 2012), pp. 70–93.

[97] South Korean Defense Acquisition Program Administration, 'About DAPA', [n.d.].

[98] Grevatt, J., 'Made in Korea: South Korea defence industry briefing', *Jane's Defence Weekly*, 1 Aug. 2018.

[99] Yonhap News Agency, 'Defense industry promotion law to take effect this week', 4 Feb. 2021; and Grevatt, J., 'South Korea enacts "foundational" defence industrial legislation', *Jane's Defence Weekly*, 4 Feb. 2021.

[100] Keck, Z., 'South Korea goes "all in" on submarines', The Diplomat, 17 Aug. 2013.

[101] Korkmaz and Rydqvist (note 96), p. 94.

[102] Béraud-Sudreau (note 4); and Wezeman et al. (note 4).

[103] Sutton, H. I., 'South Korea's first nuclear submarine looks closer', Naval News, 15 Dec. 2021; Honrada, G., 'Techno-nationalism driving Korea's CVX carrier project', Asia Times, 7 Mar. 2022; and Chandra, A., 'South Korea bets big with KF-21', Royal Aeronautical Society, 21 Sep. 2021.

Table 8.1. South Korea's domestic, licensed and imported arms as a proportion of total procurement of major conventional arms, 2016–20

	Procurement of major arms, 2016–20, volume (TIV millions)	Procurement of major arms, 2016–20, share of total volume (%)
Imports	5 981	*56.3*
Licensed	2 102	*19.8*
Domestic	4 635	*43.7*
Total	**10 617**	***100***

Table 8.2. South Korea's arms procurement by category of arms and type, 2016–20

Figures are the percentages of direct imports and licensed and domestic production for selected categories of major arms.

	Aircraft	Armour	Ships	Missiles	Air-defence systems
Imports	72.0	–	46.5	62.0	64.0
Licensed	18.4	–	46.5	–	–
Domestic	28.0	100	53.5	38.0	36.0

– = nil.

Table 8.3. South Korea's largest arms-producing and military services companies, 2020

All sales figures are in millions of current (2020) US dollars.

Rank	Name	Arms sales, 2020	Total sales, 2020	Arms sales (%)	Main products	Ownership
1	Hanwha Aerospace	2 245	4 510	*50*	Aircraft, aerospace systems, armoured vehicles	Publicly listed company
2	Korea Aerospace Industries (KAI)	1 716	2 384	*72*	Aircraft, components, satellites	Publicly listed company
3	LIG Nex1	1 357	1 357	*100*	Electronics, sensors, missiles	Publicly listed company
4	Hanwha Corp.	1 167	3 398	*34*	Ammunition, explosives	Publicly listed company
5	Daewoo Shipbuilding & Marine Engineering (DSME)	834	5 959	*14*	Ships, submarines	Publicly listed company

Note: Data on South Korean companies was provided by the Korea Institute for Industrial Economics and Trade (KIET).

The arms industry

South Korea's arms industry is comprised of the arms-producing divisions of several diversified industrial conglomerates known as *chaebols*, such as Hanwha, Hyundai and Daewoo. Many *chaebols* are controlled by a single family and are characterized by sophisticated and intertwined ownership structures. The trajectory of South Korea's arms industry is an exemplary evolution from heavy dependence on foreign supply to licensed production before achieving a high level of self-reliance, although dependence on foreign technologies remains in some areas.[104]

Hanwha Aerospace and Korea Aerospace Industries (KAI), South Korea's two largest arms companies (see table 8.3), focus on aerospace systems. KAI produces trainer and combat aircraft, while receiving technical assistance in avionics and other systems from Lockheed Martin of the USA.[105] Land systems providers such as Hanwha

[104] Jackson, S. T., 'Arms production', *SIPRI Yearbook 2011: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2011), pp. 240–44.

[105] Chinworth, M. W., 'Offset policies and trends in Japan, South, Korea, and Taiwan', eds J. Brauer and P. J. Dunne, *Arms Trade and Economic Development: Theory, Policy, and Cases in Arms Trade Offsets* (Routledge: Abingdon, 2005), p. 237; and Jacqmin, D., 'Corée du sud: L'émergence d'un nouvel exportateur majeur d'armements' [South Korea: The emergence of a new major arms exporter], Note d'analyse, Groupe de recherche et d'information sur la paix et la sécurité (GRIP), 29 Dec. 2016, p. 12.

Table 8.4. South Korea's developments in uncrewed maritime systems

Programme name	Type	Status	Company	Origin	Points
Sea Sword-II to -V	USV	Under development	LIG Nex1	Domestic	1
Unnamed	AUV	Under development	Hanwha and local research institutes, Korea Institute of Marine Science and Technology Promotion (funder)	Domestic	1
Unnamed	AUV	Under development (expected to run until 2024)	DAPA, LIG Nex1, Hanwa	Domestic	1
Cluster control technology		Under development	Hanwa, KAIST, KRISO, Donkook University	Domestic	1
Unnamed	UUV	. .	LIG Nex1	Domestic	1
ASW UUV	ASW UUV	Under development	Hanwha	Domestic	1
ASV C-Target 9	USV	In service	GigaRF, ASV Ltd (UK)[a]	Cooperation	0.5
Total					**6.5**

. . = not known/no data available; ASV = autonomous surface vehicle; ASW = anti-submarine warfare; AUV = autonomous underwater vehicle; KAIST = Korea Advanced Institute of Science and Technology; KRISO = Korea Research Institute of Ships and Ocean Engineering; USV = uncrewed surface vehicle; UUV = uncrewed underwater vehicle.

[a] L3 Technologies (now L3 Harris, USA) bought ASV Ltd in 2018.

Corporation and Hyundai Rotem produce tanks and other armoured vehicles as well as artillery systems. They exploited their advantage in civilian industrial technologies after initially receiving technological transfers from US arms companies.[106] South Korea's naval shipbuilding industry is also advanced. DSME and Hyundai Heavy Industries develop domestic major and minor surface combat and support ships. The two companies also produce submarines, originally under license from Germany but currently the much larger domestically designed KSS-3.

Uncrewed maritime vehicles

South Korea's 2018 Defence White Paper contains no direct reference to naval autonomous systems.[107] However, statements from the navy confirm an ambition to develop and procure such systems.[108] This is further reflected in the navy's 'Smart Navy' plans.[109]

Major South Korean arms companies, such as LIG Nex1 and Hanwha, have begun domestic-driven projects to develop an AUV for mine detection and a UUV for ASW missions (see table 8.4).[110] Additionally, the Agency for Defense Development (ADD) has also facilitated an industry–academia cooperation programme between large arms companies and research institutes to study USV 'clustered control technology'. This evaluates the feasibility of gathering a group of USVs via a wireless network to have robots operate in unison.[111]

[106] US Congress, Office of Technology Assessment, *Arming Our Allies: Cooperation and Competition in Defense Technology* (US Government Printing Office: Washington, DC, May 1990), appendix D, 'South Korea: Goals and strategy for building defense industries', p. 113.

[107] South Korean Ministry of National Defense (MND), *2018 Defense White Paper* (MND: Seoul: 2018). The document commits to expanding investments in cutting-edge technologies such as 'autonomous weapon systems and robots'.

[108] South Korean Navy, [2020 National Assembly National Defense Committee audit], Press release, 16 Oct. 2020 (in Korean).

[109] Yoon, S., 'Make way for South Korea's underwater drones', The Diplomat, Feb. 2020.

[110] Kim, D. Y., 'South Korea launches domestic mine detection AUV development', *Jane's Defence News*, 14 Dec. 2020; Gain, N., 'LIG Nex1 to bolster ROK Navy autonomous mine warfare capability', Naval News, 5 Jan. 2021; and Vavasseur, X., 'MADEX 2019: Hanwha Defense unveils ASWUUV for anti-submarine missions', Naval News, 22 Oct. 2019.

[111] Kim, D. Y., 'Hanwha Systems launches USV teaming technology development', *Jane's Defence Weekly*, 29 June 2020.

9. Malaysia

The Malaysian government first formulated an arms industrial policy in 1982, the National Defence Production Policy (NDPP).[112] Interest in developing self-reliance for Malaysia's armed forces began only in the late 1990s, and this was further elaborated through the 2004 Defence Industry Blueprint.[113] While the government was not seeking full self-reliance, it aimed to build local MRO capabilities.[114] The 2020 Defence White Paper provides a similarly pragmatic ambition to develop the local arms industry through 'niche-based self-reliance programmes'.[115] The government is also preparing a new national defence and security industry policy for the end of 2022, which aims to '[reduce] dependence on assets and equipment from abroad'.[116]

Arms procurement

Malaysia ranked as the world's 40th largest importer of major arms over the period 2016–20. Of the imports, 28 per cent involved some local production (see table 9.1), but this was generally limited, often to little more than the assembly of kits. No major arms were acquired domestically.

In recent years, however, Malaysia has shown that it can design and produce some types of major arms at the lower end of the technology scale, mainly light armoured vehicles and small ships. Several Malaysian companies have developed light armoured vehicles, all on imported light vehicle chassis. Malaysia reportedly ordered 148 of these in 2021.[117]

The arms industry

Malaysia has a small domestic arms industry that relies heavily on foreign technology transfers, with constrained capabilities mainly in shipbuilding in partnership with foreign companies, MRO and small arms. Unlike most other countries in South East Asia with largely state-led arms industrial bases, Malaysia's industry is scattered among over 40 private sector companies serving both military and commercial clients. This follows reforms that privatized state-owned companies in the 1990s.[118]

Over 20 private sector companies belonging to the Malaysia Defence Industry Council deliver MRO for the Malaysian Air Force or the Malaysian Navy.[119] As noted above, domestic production capacity is gradually growing through licensed production and partnerships with foreign companies, notably the production of armoured fighting vehicles by DRB-HICOM Defence Technologies (DefTech) and littoral combat ships by Boustead Heavy Industries Corporation, the respective leaders in land systems and naval shipbuilding (see table 9.2). Composites Technology Research Malaysia (now

[112] Hellmann-Rajanayagam, D., 'Malaysia', ed. Singh (note 95), p. 89.

[113] Balakrishnan, K. and Johar, T. N., 'The role of stakeholders in managing government research and development funding for defence industrial innovation: The case of Malaysia', *Defence and Peace Economics*, published online 22 July 2022

[114] Balakrishnan, K., 'Defence industrialisation in Malaysia: Development challenges and the revolution in military affairs', *Security Challenges*, vol. 4, no. 4 (summer 2008), p. 139.

[115] Malaysian Ministry of Defence (MOD), *Defence White Paper 2020: A Secure, Sovereign and Prosperous Malaysia* (MOD: Kuala Lumpur, 2020), p. 35.

[116] Bernama, 'PM: National defence and security industry policy to be launched in 1–2 months', *New Straits Times*, 11 Nov. 2021.

[117] Abas, M., 'Cendana Auto—The new defence player?', Malaysian Defence, 31 Jan. 2021.

[118] Dholakia, B. H. and Dholakia, R. H., 'Malaysia's privatization programme', *Vikalpa*, vol. 19, no. 3 (July 1994); and Malaysian Ministry of Defence, Defence Industry Division, 'Defence Industry Blueprint', 2004. See also Balakrishnan (note 114).

[119] Malaysian Industry Council for Defence Enforcement and Security, 'Company directory', [n.d.].

Table 9.1. Malaysia's domestic, licensed and imported arms as a proportion of total procurement of major conventional arms, 2016–20

	Procurement of major arms, 2016–20, volume (TIV millions)	Procurement of major arms, 2016–20, share of total volume (%)
Imports	691	*100*
Licensed	192	*27.8*
Domestic	–	–
Total	**691**	***100***

– = nil.

Table 9.2. Malaysia's largest arms-producing and military services companies, 2020

All sales figures are in millions of current (2020) US dollars.

Rank	Name	Arms sales, 2020	Total sales, 2020	Arms sales (%)	Main products	Ownership
1	DRB-HICOM Defence Technologies (DefTech)[a]	219	3 131	*7*	Armoured and other military vehicles	Publicly listed company
2	Boustead Heavy Industries Corp.	34	35	*99*	Ships, MRO	Publicly listed company
3	Destini Berhad	20	45	*45*	Components for aircraft and land systems, ammunition, MRO	Publicly listed company

MRO = maintenance, repair and overhaul.

Note: There is insufficient publicly available data to include more than 3 Malaysian companies in this ranking.

[a] The arms sales figure for this company is an estimate with a high degree of uncertainty.

part of DefTech) produces UAVs.[120] However, even this limited progress has been hampered by significant delays due to funding difficulties, corruption scandals and limited industrial capacities.[121]

Uncrewed maritime vehicles

Malaysia's 2020 Defence White Paper marked the AUV as a core area of future capability requirements for the national armed forces, and the government plans to acquire AUVs and mine-disposal vehicles.[122] However, no R&D initiative or programme seems to have been announced since the White Paper's publication or in recent years. The only evidence found is in secondary sources on the Jampiras USV prototype, which was reportedly developed by independent researchers back in 2008.[123] Some more recent information has emerged of a USV prototype built by a local firm, Powercraft Marine, although this could not be verified.[124] No ongoing programmes could thus be identified.

[120] DefTech Unmanned Systems, 'Indigenous product: UAV solutions', [n.d.]; and Abas, M., 'From Aludra to Matrice', Malaysian Defence, 1 Jan. 2021.

[121] Free Malaysia Today, '2 CEOs held in graft probe over delayed combat ships', 25 Jan. 2022; and Abas, M., 'Malaysia to resume LCS programme', Janes, 10 May 2021.

[122] Malaysian Ministry of Defence (note 115), p. 49.

[123] Naval Drones, 'Jampiras USV', [n.d.].

[124] The only reference is a tweet: John MMR (@JohnMYSreview), 'USV Design by local companies PowerCraft', Twitter, 1 Feb. 2022.

10. Pakistan

The Pakistani government established the Defence Production Division in 1972, and in 2004 upgraded it to a separate Ministry of Defence Production (MODP).[125] Efforts to sustain a domestic arms industry intensified after the United States imposed an arms embargo on Pakistan in 1990 as the USA had already suspended military assistance to Pakistan in 1979. Pakistan's arms industrial policy was also driven by the need to develop an infrastructure to support the development of nuclear weapons.[126] The MODP lists as one of its key objectives 'optimum self-reliance' through R&D, transfers of technology and offsets.[127] Moreover, the 2014 defence offset policy encouraged transfers of technologies in all large procurement contracts 'in order to ensure self-reliance'.[128]

Arms procurement

Despite the polices outlined above, imports still accounted for 97 per cent of the volume of all acquisitions of major conventional weapon systems during 2016–20 (see table 10.1). This made Pakistan the 10th largest importer of major arms globally. Licensed production accounted for 51 per cent of imports (50 per cent of procurement).

A significant part of the local capabilities has relied, and continues to rely heavily, on licensed production of Chinese major arms, including those designed specifically for Pakistan. Various projects with the USA and European suppliers resulted in some production under licence (e.g. US M-113A3 APCs in the period 2000–17), but seemingly with few cases of successful technology transfer as no further Pakistani development has been reported.

Domestic production accounted for less than 3 per cent of total procurement of major arms, almost entirely in one field: land-attack missiles. Pakistan has fielded several types of domestic ballistic missile and air-launched land-attack missile, including for use with nuclear warheads.[129] While earlier missiles are strongly suspected to have been based on designs and technology imported from China and possibly North Korea from the 1980s, most of Pakistan's missiles in this category now seem to be of domestic design.[130] However, they have only been produced in limited numbers.

The arms industry

Pakistan's arms industry is today dominated by over 20 state-owned producers. The MODP directly controls and oversees the country's five biggest producers, the respective leaders in each domain (see table 10.2). The biggest producer, Pakistan Aeronautical Complex (PAC), notably produces JF-17 combat aircraft and MFI-17 Super Mushshak training aircraft for the Pakistani Air Force.

Government agencies, R&D entities and military production units that are not arms companies according to the SIPRI definition are also important players in the industry and are often pioneers in the most cutting-edge areas. Among them, the National

[125] Pakistani Ministry of Defence Production, 'History', [n.d.].

[126] 'Pakistan's defence industry', Special report, *Asian Defence Journal*, Sep. 2004; and Grimmett, R. F., *US Arms Sales to Pakistan*, Congressional Research Service (CRS) Report to Congress RS22757 (US Congress, CRS: Washington, DC, 24 Aug. 2009).

[127] Pakistani Ministry of Defence Production, *Three Years' Performance Report (August 2018 to August 2021)* (MODP: Rawalpindi, 2021), p. 2.

[128] Pakistani Ministry of Defence Production (note 127), p. 4; and Pakistani Ministry of Defence Production, Directorate for General Defence Purchase, 'Defence offset policy', 15 Oct. 2014.

[129] Kristensen, H. M. and Korda, M., 'Pakistani nuclear forces', *SIPRI Yearbook 2022: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2022).

[130] See e.g. Missile Threat, 'Missiles of Pakistan', Center for Strategic and International Studies (CSIS), 30 June 2022.

Table 10.1. Pakistan's domestic, licensed and imported arms as a proportion of total procurement of major conventional arms, 2016–20

	Procurement of major arms, 2016–20, volume (TIV millions)	Procurement of major arms, 2016–20, share of total volume (%)
Imports	4 024	*97.4*
Licensed	2 070	*50.1*
Domestic	109	*2.6*
Total	**4 133**	***100***

Table 10.2. Pakistan's largest arms-producing and military services companies, 2019

All sales figures are in millions of constant (2020) US dollars.

Rank	Name	Arms sales, 2019	Total sales, 2019	Arms sales (%)	Main products	Ownership
1	Pakistan Aeronautical Complex[a]	450	450	*100*	Aircraft, avionics, MRO	State-owned
2	Pakistan Ordnance Factories	175	184	*95*	Conventional arms and ammunition	State-owned
3	Karachi Shipyard & Engineering Works	66	78	*85*	Shipbuilding, MRO and general heavy engineering	State-owned
4	National Radio Telecommunication Corp.	63	85	*75*	Military telecommunications systems, radar,	State-owned
5	Heavy Industries Taxila[a]	30	30	*100*	Tanks, other military vehicles	State-owned

MRO = maintenance, repair and overhaul.

Note: The Pakistani Department of Defence Production has only published sales data up to 2019. Data for 2020 is unavailable. Sales figures for 2019 are converted to 2020 US dollars to allow comparison with the other case studies.

[a] The arms sales figure for this company is an estimate with a high degree of uncertainty.

Engineering and Scientific Commission (NESCOM), the Space and Upper Atmosphere Research Commission (SUPARCO), and the R&D establishment of the MODP are all key R&D units developing ballistic missiles, UAVs, and command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) systems.[131]

Despite recent efforts by the government to enhance the participation of the private sector in military procurement in order to boost industry competitiveness and efficiency, Pakistan's private arms companies remain relatively nascent.[132] All private arms suppliers are SMEs and are mainly involved in land systems and military electronics.[133]

Uncrewed maritime vehicles

Limited open-source information is available regarding Pakistan's plans to pursue the development and procurement of USVs and UUVs. The MODP's *Year Book 2018–21* makes no reference to naval autonomous systems.[134] In 2020 Zafar Mahmood Abbasi, chief of the Naval Staff, mentioned establishing a naval R&D institute to foster some domestic effort in studying naval systems, including autonomous underwater technology.[135] Although there are reports that this centre does research on UUVs, no specific programme or initiative has been identified.[136]

[131] Nuclear Threat Institute (NTI), 'National Engineering and Scientific Commission (NESCOM)', 17 Dec. 2021; Pakistani Senate, Committee on National Defence, 'Defence Science & Technology Organization', [n.d.]; and Nuclear Threat Institute (NTI), 'Space and Upper Atmosphere Research Commission Suparco', 17 Dec. 2021.

[132] Grevatt, J., 'Pakistan outlines plans to revive defence industrial base', *Jane's Defence Weekly*, 9 Sep. 2020.

[133] Defence Export Promotion Organization, 'Pakistan defence industries catalogue: Private sector', [n.d.].

[134] Pakistani Ministry of Defence Production (MODP), *Year Book 2018–21* (MODP: Rawalpindi, 2021).

[135] Ansari, U., 'Outgoing Pakistan Navy chief reveals details of modernization programes', *Defense News*, 14 Oct. 2020; and ARY News, '"Made in Pakistan" warship realization of self-reliance dream, says Navy chief', 30 Dec. 2019.

[136] Samran, A., 'Anti-access/areadenial [*sic*] strategy for Pakistan Navy: A work in progress', *CISS Insight*, vol. 9, no. 1 (2021), p. 47.

11. Singapore

Given its relatively small size, Singapore has no ambition to approach self-reliance across the whole spectrum of force requirements. Nonetheless, policies to foster the development of local arms-production capabilities began in the late 1960s, soon after the country's independence. These included the use of offsets and technology transfers in arms import contracts.[137] The initial ambitions were to achieve limited self-reliance in the manufacturing of ammunition and small arms and MRO capabilities. Progressively, Singapore's government and industry focused on innovation and niche products to gain a competitive edge. Several government agencies, such as the Defence Science and Technology Agency (DSTA) and the Defence Science Organisation (DSO) National Laboratories, support military innovation policies, to ensure that the Singaporean armed forces are equipped with technologically advanced weapon systems.[138]

Arms procurement

Singapore was the 18th largest importer of major arms globally over the period 2016–20. Imports accounted for 72 per cent of the volume of all acquisitions (see table 11.1).

However, compared to the other states included in this report, Singapore has a fairly high level of domestic production: 28 per cent of its acquisitions of major arms. In 2016–20 all ships and most armoured vehicles acquired by Singapore were of domestic design. Moreover, their designs were advanced (e.g. the Hunter infantry fighting vehicle was even offered as a candidate in a competition for the US military).[139] However, some major components, such as engines and other propulsion-related systems, some of the armament and most of the sensors, were imported.

In contrast, Singapore scores relatively low in the level of licensed production in imported major arms: just 1 per cent. The only imported major arms in 2016–20 with a local input were Marauder APCs from South Africa, a variant of which is produced in Singapore.[140]

The arms industry

Singapore's arms industrial base is an integrated ecosystem comprised of the Ministry of Defence, the Singaporean armed forces, research institutes and ST Engineering at the core. Temasek Holdings, whose sole shareholder is Singapore's finance minister, holds a majority of the shares in ST Engineering. Besides ST Engineering, Singapore's arms industry is also comprised of a few foreign subsidiaries (see table 11.2) and domestic SMEs.[141]

The powerhouse ST Engineering ranked 61st in the global arms industry Top 100 in 2020 and 13th in the regional top 50 (see table 15.2).[142] It is involved in almost all military procurement programmes. For the past two decades, its four sector-based subsidiaries—ST Aerospace, ST Kinetics, ST Marine and ST Electronics—have been the foundation of Singapore's arms industry. The capabilities of its aerospace and

[137] Matthew, R. and Koh, C., 'Singapore's defence-industrial ecosystem', eds Hartley and Belin (note 84).

[138] Tan, A. T. H., 'Singapore's defence industry: Its development and prospects', *Security Challenges*, vol. 9, no. 1 (2013), p. 66.

[139] Yeo, M., 'ST Kinetics prepping to hand over bid in US Army's vehicle competition', *Defense News*, 14 Feb. 2018.

[140] ST Engineering, 'ST Engineering and Paramount Group unveil comprehensive variants of world-renowned Belrex protected vehicles', News release, 19 Sep. 2018; and Army Technology, 'Belrex Protected Combat Support Vehicle (PCSV)', 25 Jan. 2021.

[141] Defence Industries Association, 'Current members', 1 Mar. 2020.

[142] SIPRI Arms Industry Database (note 3); and Marksteiner et al. (note 3).

Table 11.1. Singapore's domestic, licensed and imported arms as a proportion of total procurement of major conventional arms, 2016–20

	Procurement of major arms, 2016–20, volume (TIV millions)	Procurement of major arms, 2016–20, share of total volume (%)
Imports	2 354	*72.2*
Licensed	33	*1.0*
Domestic	906	*27.8*
Total	**3 260**	***100***

Table 11.2. Singapore's largest arms-producing and military services companies, 2020

All sales figures are in millions of current (2020) US dollars.

Rank	Name	Arms sales, 2020	Total sales, 2020	Arms sales (%)	Main products	Ownership
1	ST Engineering	1 885	5 221	*36*	Armoured vehicles, aerospace MRO, ships, electronics	State-owned
2	Raytheon Technologies Singapore[a]	760	1 169	*65*	Aircraft MRO, radars.	Foreign subsidiary
3	Thales Singapore[a]	214	454	*47*	Sensors, radars, UAVs.	Foreign subsidiary

MRO = maintenance, repair and overhaul; UAV = uncrewed aerial vehicle.

Note: There is insufficient publicly available data to include more than 3 Singaporean companies in this ranking.

[a] The arms sales figure for this company is an estimate with a high degree of uncertainty.

Table 11.3. Singapore's developments in uncrewed maritime systems

Programme name	Type	Status	Company	Origin	Points
Maritime Security (MARSEC) USV	USV	Expected in service 2022	DSTA, ST Engineering, DSO National Laboratories, Singaporean Navy (reportedly based on Lungteh design; incorporates Rafael Toplite electro-optical infrared turret)	Cooperation	0.5
Venus 16	USV	In service	ST Engineering, Lungteh (Taiwan)	Cooperation	0.5
Meredith/ Mercury	AUV	Under development	DSO National Laboratories, ST Engineering	Domestic	1
Long-endurance USV (LEUSV)	USV	.. (concept phase)	ST Engineering	Domestic	1
Vigilant	USV	Under development	Zycraft	Domestic	1
Dolphin	USV	Under development	Zycraft	Domestic	1
Protector	USV	In service	Rafael (Israel)	Foreign	0
Spartan Scout	USV	In service (technology demonstrator)	Northrop Grumman (USA), Raytheon (USA), Radix Marine (USA)	Foreign	0
Total					**5**

AUV = autonomous underwater vehicle; DSO = Defence Science Organisation; DSTA = Defence Science and Technology Agency; USV = uncrewed surface vehicle.

shipbuilding branches mainly lie in MRO, components and combat systems, but it has produced indigenous military vehicles and electronics systems. From the beginning of 2021, ST Engineering was reorganized to consolidate the four sector-based subsidiaries into a single cluster encompassing all defence business areas, with the aim of achieving better integration and more success in the global market.[143]

[143] ST Engineering, 'ST Engineering reorganises for global growth and success', Press release, 17 Nov. 2020.

Uncrewed maritime vehicles

The Singaporean defence establishment emphasizes the significance of autonomous technologies and their application in modern and future warfare.[144] It has already begun to work with local companies to apply innovation from the civilian sector to the military domain.

The Singaporean Navy has identified the acquisition of uncrewed systems as a way to enhance its capabilities.[145] It has thus started operating two USVs: a mine countermeasures USV, developed by the navy itself (although the mine-disposal mechanism that neutralizes the mines is of French origin);[146] and the Protector USV dedicated to coastal defence, built by the Israeli company Rafael (see table 11.3).[147] There also appears to be ongoing cooperation with the Taiwanese company Lungteh.[148] ST Engineering has been developing other types of USV and AUV, including the Maritime Security (MARSEC) USV and Mercury, in cooperation with foreign and Singaporean companies, respectively.[149] Overall, Singapore adopts a rather pragmatic approach by simultaneously fostering domestic effort and embracing international offers.

[144] Tham, T., 'Game changers of defence tech', Pioneer, Singaporean Ministry of Defence, 31 May 2019; and Raska, M., 'Singapore's next-frontier defence innovations', *Straits Times*, 27 June 2018

[145] Singaporean Ministry of Defence, 'Unmanned surface vessels to enhance maritime security', Fact sheet, 1 Mar. 2021.

[146] Naval News, 'Navy of Singapore has conducted operational tests with its Mine Countermeasure Unmanned Surface Vessel', 22 July 2021; Singaporean Navy, 'Mine countermeasure unmanned surface vessels', [n.d.]; and ECA Group, 'K-Ster C—Expendable mine disposal vehicle/EMDS', [n.d.].

[147] Singaporean Navy, 'Protector unmanned surface vehicle', [n.d.]; and Rafael, 'Protecter USV'.

[148] Wong, K., 'Taiwan-built 16m USV for Singapore Navy unmanned systems development breaks cover', *Jane's International Defence Review*, 9 Oct. 2020; and Wong, K., 'Sea Guardian: Singapore aims to boost maritime security with MRSEC USVs', *Jane's International Defence Review*, 23 Apr. 2021.

[149] Open Source Military Intelligence, 'Mercury mine countermeasure autonomous underwater vehicle', 1 June 2019; and Lundquist, E. H., 'Zycraft Vigilant combines speed, payload, and endurance', Defense Media Network, 15 Aug. 2013.

12. Taiwan

While Taiwan is heavily reliant on US military assistance, it has sought to develop domestic arms-production capabilities in case of delays in US decision-making or potential refusals to supply certain types of weapon.[150] The government's efforts have intensified in recent years. After becoming president in 2016, Tsai Ing-wen implemented a new arms industrial policy. Development of an indigenous submarine and aircraft were the key priorities, which translated into an indigenous submarine programme.[151] While arguably this endeavour still relies on foreign assistance to some extent, the political willingness and associated funding have been notable since the start of Tsai's presidency.[152] The 2019 Defense Industry Development Act defines mechanisms to 'promote self-reliant technology'.[153] The 2021 Quadrennial Defense Review further stresses that the Ministry of National Defense 'consistently moves towards self-reliant defense' and outlines measures to meet this ambition.[154]

Arms procurement

Taiwan accounted only for 0.6 per cent of the world total over the period 2016–20, ranking as the 34th largest importer.

Imports accounted for 36 per cent of the total volume of procurement of major arms (see table 12.1). However, there are large ongoing or planned import programmes that are likely to increase the import share in coming years. All major arms originated from the United States, due to the reluctance of other suppliers to openly assist Taiwan.[155] While production under licence has been a feature in Taiwan's arms imports in the past, none of the imports in 2016–20 included any local involvement in production. The planned imports also do not include local involvement in production.

Domestic production accounted for 64 per cent of procurement. This was focused on missiles, which accounted for 56 per cent of total acquisitions. These included advanced long-range anti-ship, land-attack and air-defence missiles that all seem to be fully domestic. Armoured vehicles accounted for the rest of domestic production. However, they use imported engines, armaments and other technologies.

There are also plans to acquire armed UAVs, various types of surface combat and support ships, and light and heavy armoured vehicles.[156] Taiwan has also started to produce more advanced weapons, including 8 indigenous submarines and 66 Brave Eagle trainer/combat aircraft, both with US technical assistance.[157]

The arms industry

Taiwan's arms industry is centred around state-owned or formerly state-owned arms producers and a few smaller shipbuilders (see table 12.2), supported by a group of

[150] An, D., Schrader, M. and Collins-Chase, N., *Taiwan's Indigenous Defense Industry: Centralized Control of Abundant Suppliers* (Global Taiwan Institute: Washington, DC, May 2018); and Béraud-Sudreau, L. and Dempsey, J., 'Indigenous submarines: Not quite made in Taiwan?', IISS Military Balance blog, 20 Aug. 2018.

[151] New Frontier Foundation (NFF), Defense Policy Advisory Committee, *Bolstering Taiwan's Core Defense Industries*, Defense Policy Blue Paper no. 7 (NFF: Taipei, Oct. 2014).

[152] Saito, M. et al., 'T-Day: The battle for Taiwan', Reuters, 29 Nov. 2021.

[153] Defense Industry Development Act, Law of the Republic of China (Taiwan), promulgated 19 June 2019, Article 11.

[154] Taiwanese Ministry of National Defense (MND), *Quadrennial Defense Review 2021* (MND: Taipei, 2021), p. 48.

[155] Bräuner, O., 'How Europe shies from Taiwan', The Diplomat, 20 Mar. 2012.

[156] Morgan, S., 'Taiwan plans military drone fleet to protect coast', *Taiwan News*, 4 Sep. 2019; and Saballa, J., 'Taiwan developing two new military vehicles', Defense Post, 29 Mar. 2022.

[157] Strong, M., 'Taiwan tests first two domestic Brave Eagle jet trainers to replace F-5s', *Taiwan News*, 2 Mar. 2021.

Table 12.1. Taiwan's domestic, licensed and imported arms as a proportion of total procurement of major conventional arms, 2016–20

	Procurement of major arms, 2016–20, volume (TIV millions)	Procurement of major arms, 2016–20, share of total volume (%)
Imports	852	*36.2*
Licensed	–	–
Domestic	1 503	*63.8*
Total	**2 355**	***100***

– = nil.

Table 12.2. Taiwan's largest arms-producing and military services companies, 2020

All sales figures are in millions of current (2020) US dollars.

Rank	Name	Arms sales, 2020	Total sales, 2020	Arms sales (%)	Main products	Ownership
1	National Chung-Shan Institute of Science and Technology (NCSIST)	1 692	1 799	*94*	Aerospace, C4ISR, missiles	State-owned
2	CSBC Corp.	520	859	*61*	Ships	Publicly listed company
3	Aerospace Industrial Development Corp. (AIDC)	422	714	*59*	Aerospace, electronics	Publicly listed company
4	Jong Shyn Shipbuilding[a]	22	145	*15*	Ships	Private

C4ISR = command, control, communications, computers, intelligence, surveillance and reconnaissance.

Note: There is insufficient publicly available data to include more than 4 Taiwanese companies in this ranking.

[a] The arms sales figure for this company is an estimate with a high degree of uncertainty.

over 30 SMEs in lower tiers.[158] In response to risks and uncertainty regarding foreign imports as a result of pressure from China, Taiwanese arms companies have developed self-reliance in a range of platforms.[159] These include combat aircraft, missiles, ships and armoured vehicles, although all have relied on imported technologies to some degree.

Taiwan's largest arms company is the National Chung-Shan Institute of Science and Technology (NCSIST), which specializes in missiles, UAVs and C4ISR. The Aerospace Industrial Development Corporation (AIDC) is the leader in aerospace and has produced the Indigenous Defense Fighter and trainer aircraft together with NCSIST. The military-run Ordnance Readiness Development Center is the leading domestic producer of land systems, including armoured vehicles and artillery. However, it is not an arms company according to the SIPRI definition.

CSBC Corporation, a former state-owned enterprise privatized in 2008, is responsible for most of Taiwan's indigenous naval shipbuilding. It is currently developing Taiwan's first indigenous submarines with technical assistance from US suppliers and know-how from other Western countries.[160] Benefiting from growing demand under the Indigenous National Naval Defense project, smaller private shipbuilders such as Lungteh and Jong Shyn Shipbuilding have also received orders for corvettes, attack craft and patrol vessels.[161]

[158] Taiwan Defense Industry Development Association, 'Member directory', [n.d.].

[159] Sik, K., 'The Dutch–Taiwanese submarines deal: Legal aspects', *Netherlands Yearbook of International Law*, vol. 13 (1982).

[160] Saito et al. (note 152).

[161] Taiwanese Navy Command, [Indigenous National Naval Defense], [n.d.] (in Chinese).

Table 12.3. Taiwan's developments in uncrewed maritime systems

Programme name	Type	Status	Company	Origin	Points
Hui Long	UUV	Under development	NCSIST	Domestic	1
Unnamed testing vessel	UUV	Under development	NCSIST	Domestic	1
Unnamed indigenous project	AUV	Under development	Jong Shyn Shipbuilding, CSBC Corp., National Sun Yat-sen University	Domestic	1
Venus 16[a]	USV	In service in Singapore	Lungteh, ST Engineering (Singapore)	Cooperation	0.5
Maritime Security (MARSEC) USV[a]	USV	Expected in service 2022 in Singapore	DSTA, ST Engineering, DSO National Laboratories, Singapore Navy (all Singapore; reportedly based on Lungteh design; incorporates Rafael Toplite electro-optical infrared turret)	Cooperation	0.5
Total					**4**

AUV = autonomous underwater vehicle; DSO = Defence Science Organisation (Singapore); DSTA = Defence Science and Technology Agency (Singapore); NCSIST = National Chung-Shan Institute of Science and Technology; USV = uncrewed surface vehicle; UUV = uncrewed underwater vehicle.

[a] Venus 16 and MARSEC are Singaporean programmes but reportedly based on Taiwanese designs, so they are also included in Taiwan's list of programmes.

Uncrewed maritime vehicles

Taiwan's 2017 Quadrennial Defence Review announced plans to invest more in uncrewed underwater technologies.[162] Taiwan planned to launch its first indigenous AUV within five years of 2017, but no details on progress are yet available.[163]

In 2019 the government provided funds of 3.6 billion New Taiwan dollars (US$116.5 million) for the Hui Long project to build a few small-to-medium-sized uncrewed testing vessels, with the aim of 'reducing the indigenous submarine program's reliance on foreign governments'.[164] The company Lungteh is particularly active in the field, cooperating with ST Engineering from Singapore on several projects (see table 12.3).

[162] Taiwanese Ministry of National Defense (MND), *2017 Quadrennial Defense Review* (MND: Taipei, 2021).

[163] Focus Taiwan, 'Taiwan plans to launch its first indigenous AUV within 5 years', 1 Sep. 2017.

[164] Lo, T. and Chin, J., 'Institute developing UUV as test bed for submarines', *Taipei Times*, 12 July 2021; and Luo, T., [National defence Made in Taiwan: New information about NCSIST Hui Long project exposed], Liberty Times Net, 10 July 2021 (in Chinese).

13. Thailand

Thailand's current ambition in developing its domestic arms industry is embodied in the Defence Technology Institute (DTI), the country's main military R&D entity. After its foundation in 2009, it began working on Chinese licensed programmes.[165] Attempts to introduce legislation on offsets began in 2012 but have so far not succeeded.[166] The Thai Air Force, however, has separately implemented technology-transfer requirements in its procurements.[167] Thailand has recently implemented new policy plans to expand its arms industry: in 2020 it established the Defence Industry and Energy Centre, which will have a coordination and planning role in 'work in the field of defence industry'.[168] While the goal is to move towards increased self-reliance, Thai officials recognize the need for international partnerships to develop local capabilities.[169]

Arms procurement

Thailand is a relatively small importer at the global level, ranking as the 22nd largest importer of major arms globally over the period 2016–20. Imports accounted for 98 per cent of Thailand's procurement of major arms. With a limited local arms industry, procurement programmes seldom include a local component or technology transfers. Production under licence accounted for less than 3 per cent of imports (see table 13.1) and was limited to 1 small offshore patrol vessel and 15 multiple rocket launchers (MRLs).

At least since the 1950s, local production and domestic design capabilities have been limited to small numbers of simple designs. Domestic production accounted for only 2 per cent of total procurement in 2016–20 and was limited to three patrol craft and two light armoured vehicles. Some programmes for local development of major arms have been recently announced, mainly by the DTI.[170] Examples of local programmes include the D-Eyes 04 UAV and a 105-millimetre self-propelled gun—both unveiled in 2021 and based on Chinese designs, but neither yet existing as a prototype.[171] Plans for more advanced MRLs and armoured vehicles have also been mentioned.[172]

The arms industry

A large share of Thailand's national arms production is owned and run directly by the Thai armed forces. These military-affiliated production units, which publish limited information on their sales, are supported by a small and fragmented private sector, with over 40 companies.

The biggest state-owned enterprise with available information is Thai Aviation Industries, owned by the Thai Air Force (see table 13.2). It is the main provider of MRO

[165] Defence Technology Institute (DTI), [Milestones], [n.d.] (in Thai); and Grevatt, J., 'Thailand launches indigenous defence projects', *Jane's Defence Industry*, 27 Nov. 2009; and Army Recognition, 'Thailand and China will jointly develop the DTI-1G MLRS rocket launcher with guidance system 3004121', 30 Apr. 2012.

[166] Grevatt, J., 'Thai offset plans could be derailed by a move to reinstate countertrade', *Jane's Defence Industry*, 26 Nov. 2012; and Grevatt, J., 'Thai offset policy plans lose momentum', *Jane's Defence Weekly*, 4 Nov. 2015.

[167] Key Aero, 'Achieving superiority: Modernising the Royal Thai Air Force', 18 Jan. 2022.

[168] Thai Ministry of Defence, Defence Industry and Energy Centre, [Mission] (in Thai); and Saperstein, H. T., 'A reckoning for Thailand's indigenous defence industry', The Interpreter, Lowy Institute, 9 Dec. 2020.

[169] 'New complex for weapons production', *Bangkok Post*, 21 Feb. 2020.

[170] Saperstein, H. T., 'Thailand's Defence Technology Institute: A peek behind the [not-so-metaphorical] iron curtain', Asia Centre, 25 Nov. 2021, </>.

[171] Grevatt, J., 'Thailand initiates light gun technology project', Janes, 23 Sep. 2021; and Ng, J., 'Thailand pursues new tactical-class UAV, based on a Chinese design', *Asian Military Review*, 2 July 2021.

[172] 'A glimpse of Thailand's defence industry in 21st century', Asian Defense, 9 Nov. 2021.

Table 13.1. Thailand's domestic, licensed and imported arms as a proportion of total procurement of major conventional arms, 2016–20

	Procurement of major arms, 2016–20, volume (TIV millions)	Procurement of major arms, 2016–20, share of total volume (%)
Imports	1 735	*98.0*
Licensed	49	*2.8*
Domestic	35	*2.0*
Total	**1 770**	***100***

Table 13.2. Thailand's largest arms-producing and military services companies, 2020

All sales figures are in millions of current (2020) US dollars.

Rank	Name	Arms sales, 2020	Total sales, 2020	Arms sales (%)	Main products	Ownership
1	Thai Aviation Industries[a]	117	130	*90*	Aerospace, MRO	State-owned
2	Marsun[a]	115	320	*36*	Ships	Private
3	Defence Technology Institute (DTI)	38	38	*100*	R&D	State-owned
4	Chaiseri Metal & Rubber[a]	32	32	*100*	Armoured vehicles	Private
5	Bangkok Dock	3.5	5.2	*67*	Ships	State-owned

MRO = maintenance, repair and overhaul; R&D = research and development.

[a] The arms sales figure for this company is an estimate with a high degree of uncertainty.

Table 13.3. Thailand's developments in uncrewed maritime systems

Programme name	Type	Status	Company	Origin	Points
Underwater training UUV	UUV	In service	Thai Navy, Kasetsart University, Triumph Engineering	Domestic	2
Unnamed 10-m USV	USV	Under development (concept)	Marsun	Domestic	1
Riverine Operation Boat Autonomous Surface Technology (ROBAST)	USV	. .	Thai Navy; Marsun	Domestic	1
Total					**4**

. . = not known/no data available; USV = uncrewed surface vehicle; UUV = uncrewed underwater vehicle.

services for aircraft, engines and avionics. Among the biggest private sector firms, Marsun is the leader in shipbuilding and has produced small patrol vessels for the Thai Navy, with the help of foreign companies. While factories owned by the Thai Army manufacture mostly small arms and ammunition, Chaiseri Metal & Rubber stands out as the biggest land systems producer and arms-exporting company in the private sector, making light armoured vehicles for the army in cooperation with the DTI.[173]

Uncrewed maritime vehicles

Thailand's National Strategy for 2018–37 and the Immediate Policy of the Minister of Defence for 2021/22 mention neither AUVs nor USVs.[174] The Naval Strategy for 2017–36 includes generic comments on the importance of promoting research, development and military innovation systems for the navy, without mention of specific programmes or missions.[175]

[173] Defense Studies, 'DTI and Chaiseri Thailand to export First Win 4x4 vehicle to the Philippines', 17 May 2022.

[174] Thai National Strategy Committee (NSC), *National Strategy 2018–2037* (NSC: Bangkok, 2018); and Thai Ministry of Defence (MOD), *Immediate Policy of the Minister of Defence for Fiscal Year 2022* (MOD: Bangkok, Oct. 2021).

[175] Thai Ministry of Defence (MOD), [Naval Strategy 2017–2036] (MOD: Bangkok, 2017).

The most recent identified test of a UUV by the Thai Navy, for sonar training and submarine detection, was in 2010.[176] It has been mentioned in recent news reports, and is thus still worth recording here (see table 13.3). In 2011 the Thai Navy ordered three SeaFox mine disposal UUVs from Germany's Atlas Elektronik.[177] These are tethered and therefore not included here. Shipbuilder Marsun appears particularly active in the field of uncrewed naval systems.[178]

[176] Defense Studies, 'Royal Thai Navy tests UUV', 31 May 2010; and Seafarer Library, [Unmanned underwater vehicles (UUVs)], [n.d.] (in Thai).

[177] Shephard News, 'Thailand orders SeaFox AUV', 8 Dec 2011.

[178] Arthur, G., 'D&S 2017: Marsun charts future USV course', Shephard, 8 Nov. 2017.

14. Viet Nam

Viet Nam's official policies for development of the local arms industry include its 2014 public procurement legislation. This applies to military products and sets an offset preference of 25 per cent of total contract value for domestic production.[179] The 2019 National Defence White Paper states the government's objective to develop its arms industry. It aims to 'move toward the formation of self-control, high-tech, and dual-use defence industrial groups' by taking advantage of international cooperation and exploiting dual-use technologies.[180] This was followed by new legislation in 2020, the Ordinance on National Defence Industry, and plans for another law on the national defence industry.[181] Little information is available in the public domain on the content of either piece of legislation.

Arms procurement

Viet Nam was the 16th largest importer of major arms globally over the period 2016–20. Almost none of its procurement in this period was from domestic design and production, the lowest of the 12 case studies (see table 14.1). The only major arms of domestic design identified as being delivered in 2016–20 were a small number of two types of small reconnaissance UAV.[182] Designs of larger, potentially armed, UAVs are reportedly under development.[183] The only other identified local major arms designs are simple truck-mounted artillery systems, but it is unclear if these have gone beyond the prototype stage.[184]

The level of local involvement in imported major arms is 11 per cent. In 2016–20 Viet Nam produced or assembled ships, radars and missiles of foreign design. However, this was limited to small numbers of rather simple designs such as patrol vessels and landing craft. It is likely that the local content in production of foreign designs is limited in scope and in level of technology (e.g. the hulls of the patrol vessels are locally produced, but the engines and electronics are imported). Negotiations have in recent years been reported with several potential suppliers, including India, France and the Netherlands, for additional orders for major arms with a local content.[185]

The arms industry

Viet Nam's arms industrial base mainly consists of SOEs and arms-production factories under the Ministry of National Defence. Due to a lack of transparency, the value of most Vietnamese companies' arms sales is unknown.

Like Chinese SOEs, Vietnamese enterprises operate in a diverse array of civilian sectors including telecommunications, commodities, consumer goods and service industries, in alignment with the government's priority of developing a 'dual-use

[179] Law No.43/2013/Qh13 of the Vietnamese National Assembly 'On bidding', 26 Nov. 2013, Article 14, p. 16.

[180] Vietnamese Ministry of National Defence (MND), *2019 Viet Nam National Defence* (National Political Publishing House: Hanoi, Oct. 2019), pp. 39, 102.

[181] Vietnam Law & Legal Forum, 'Development of national defense-security industry reviewed', 6 Apr. 2020.

[182] Avia.pro 'Viettel VT-Patrol', 7 Dec. 2016; and VietDefense, Facebook post, 'Heres a look at the VT-Pigeon UAVs manufactured by the Viettel Military Industry and Telecoms Group. Technical specifications directly taken from Viettel's website have been provided in the last image', 14 Nov. 2020. Both UAVs are about 26 kilograms when fully loaded, which is just within the limits of the SIPRI definition of major arms.

[183] Mitzer, S., 'Red star rising: Vietnam's armed drone project', Oryx, 21 Jan. 2022; and Tay, K., 'Beyond ISR: Is Vietnam developing an armed UAV?', IISS Military Balance Blog, 16 Oct. 2020.

[184] Giusti, A., 'PTH 130-K225B 130 mm self-propelled gun', Online Tank Museum, 23 May 2022.

[185] Defense Studies, 'Vietnamese Navy want Sigma 10514 replacing Sigma 9814', 27 June 2016; Defense Studies, 'Vietnam wishes to buy French's Gowind warship rather than Sigma 9814', 20 June 2016; and Jha, S., 'Can India break into Vietnam's defense market', The Diplomat, 5 Dec. 2018.

Table 14.1. Viet Nam's domestic, licensed and imported arms as a proportion of total procurement of major conventional arms, 2016–20

	Procurement of major arms, 2016–20, volume (TIV millions)	Procurement of major arms, 2016–20, share of total volume (%)
Imports	2 487	*100*
Licensed	264	*10.6*
Domestic	<0.5	*<0.05*
Total	**2 487**	***100***

Table 14.2. Viet Nam's largest arms-producing and military services companies, 2020

All sales figures are in millions of current (2020) US dollars.

Rank	Name	Arms sales, 2020	Total sales, 2020	Arms sales (%)	Main products	Ownership
1	Viettel High Technology Industries Corp.	323	1 500	*22*	UAVs, radars	State-owned
2	Z189 Shipyard	38	38	*100*	Ships, MRO	State-owned

MRO = maintenance, repair and overhaul; UAV = uncrewed aerial vehicle.

Note: There is insufficient publicly available data to include more than 2 Vietnamese companies in this ranking.

defence and security industry'.[186] A case in point is Viettel Military Industry and Telecoms Group, an MND-owned multinational telecommunications company that is among the four largest businesses in Viet Nam.[187] Its military branch, Viettel High Technology Industries Corporation (VHT), is a leader in developing Viet Nam's C4ISR technologies including UAVs, electronic warfare and radars (see table 14.2). In other domains, military-owned facilities provide limited self-reliance in the production of ordnance, small naval vessels and MRO for mainly Soviet-made systems, but they work with foreign companies on more complex systems and MRO. These include Factory A32, which supplies aircraft MRO, Z189 Shipyard, which produces patrol vessels, and Factory X52, which maintains submarines.

Uncrewed maritime vehicles

There is no reference to USVs or UUVs in the 2019 National Defence White Paper.[188] It was not possible to identify Vietnamese or foreign-supplied UUV or USV programmes. The limited university-initiated efforts on prototypes of USVs and AUVs could possibly have military applications.[189] Given the importance of the maritime domain for Viet Nam's defence policy and the overall lack of transparency in military affairs in the country, it is possible that programmes exist but have not yet been disclosed publicly. No assessment can thus be made of Viet Nam's level of self-reliance in the field of USV and UUVs.

[186] 'Viettel on the way to becoming a world leading defense industry group', *People's Army Newspaper*, 28 Feb. 2021.
[187] Vietnam News Agency, 'Vietnam's 500 largest businesses in 2021 revealed', VietnamPlus, 30 Nov. 2021.
[188] Vietnamese Ministry of National Defence (note 180).
[189] VietNamNet Global, 'Vietnamese scientists to make autonomous underwater vehicles', 8 Sep. 2019.

15. Comparing levels of self-reliance in arms production in the Indo-Pacific region

This concluding chapter brings together the three dimensions of self-reliance in arms production in the Indo-Pacific region to establish an overall ranking of the case studies (see table 15.1). Given the limited access to information on Viet Nam for indicators 2 and 3, it is not included in the final ranking.[190]

Interpreting the ranking

The results are not entirely surprising. As could be expected, the most self-reliant countries when it comes to arms production are some of the larger and wealthier states: China (rank 1), Japan (rank 2) and South Korea (rank 3). These three are among the four largest military spenders in the case studies (see table 1.1). China dominates the ranking, with a score more than two and a half higher than Japan's. India's domestic arms companies provide only 16 per cent of its total procurement. However, the significant arms sales of local firms and the high level of licensed production push India to fourth position in the list. This should be to put in perspective against the fact that India is the second largest military spender in the region, after China.

Taiwan, Australia and Singapore rank fifth, sixth and seventh, respectively, in terms of self-reliance, forming a middle tier in the ranking. This position is in line with their regional military expenditure levels. Although Taiwan has lower military expenditure and smaller arms companies than the most self-reliant countries, its relatively high ranking can be attributed to its specific geopolitical circumstances and limited access to foreign military equipment. In South Asia, Pakistan ranks relatively low (rank 8) since it remains highly dependent on China for its arms acquisitions. The remaining South East Asian states for which data is available—Indonesia (rank 9), Malaysia (rank 10) and Thailand (rank 11)—are significantly less self-reliant than their larger and wealthier neighbours.

Arms procurement

The average share of imports in the total volume of arms procurement is 72 per cent, with wide variations: ranging from 8 per cent for China up to 97 for Pakistan, 98 for Australia and Thailand and 100 per cent for Malaysia and Viet Nam. However, licensed production is an important part of national arms-production capabilities in some instances.

Australia (rank 6) has the highest score of all 12 cases for this sub-indicator. This is in line with the fact that it relies to a large extent on the United States for its arms procurement (69 per cent of imports between 2016 and 2020; see table 1.1) but in return benefits from technology transfers to develop its domestic arms industry. Licensed production is also a significant part of the self-reliance score for India (rank 4), Pakistan (rank 8), Indonesia (rank 9) and Malaysia (rank 10). This is a sign of the relative reliance of these states' arms production capabilities on technology transfers rather than on domestic designs.

The arms industries

China dominates the ranking when it comes to the sub-indicators on company arms sales, dwarfing the results for the other case studies. This is due not only to the combined arms sales of the top 3 companies of each country (sub-indicator 2(a)), but

[190] For the methodology on the self-reliance score, see chapter 2 in this volume.

Table 15.1. Ranking of self-reliance in arms production in the Indo-Pacific

The table presents re-based indicators, ranging from 0 to 100, rounded. Intermediate calculation sheets are available from the authors upon request.

		Indicator/Sub-indicator (weight)					
		Indicator 1 Procurement of major arms		*Indicator 2* Arms company sales			
Rank	Country	*1(a)* Domestic production share (×1)	*1(b)* Licensed production share (×0.5)	*2(a)* Share of total sales in top 50 (×1)	*2(b)* Top 3 total sales (×1)	*Indicator 3* Uncrewed maritime vehicles (×0.25)	Self-reliance score
1	China	100	10	100	100	100	330
2	Japan	80	24	13	15	42	131
3	South Korea	48	29	10	10	36	92
4	India	21	83	9	12	31	90
5	Taiwan	70	–	3	5	22	83
6	Australia	2	100	5	4	25	67
7	Singapore	30	1	3	5	28	46
8	Pakistan	2	72	1	1	–	40
9	Indonesia	6	50	–	–	–	31
10	Malaysia	–	41	–	–	–	21
11	Thailand	1	4	–	–	22	9

– = <0.5.

Notes: Rounding in this table is to the nearest full number. Viet Nam is not included in the final ranking due to a lack of data.

also to Chinese firms' share of the total sales of the regional top 50 arms companies (see table 15.2). This top 50 ranks the Indo-Pacific's largest arms-producing and military services companies by their arms sales, accounting for revenue from both domestic and export military customers. Chinese companies accounted for 70 per cent of the aggregated sales of the regional top 50 in 2020. Notably, only 8 Chinese firms are included in the list since data on additional Chinese firms is not available, while more companies from Japan (10 firms) and South Korea (9 firms) are ranked.

The arms industries of the 12 case studies are at distinct stages of self-reliance. As summarized by Bitzinger et al., these stages are, successively, (*a*) low-technology arms-production capabilities (e.g. small arms); (*b*) large arms industry but limited R&D capabilities; (*c*) emerging arms industrial complexes; (*d*) niche but advanced arms production; and (*e*) across-the-board development and manufacturing of major arms.[191] China is the only country in the region that can produce complex weapon systems in all sectors. Firms in Australia, Japan, South Korea, Singapore and Taiwan have developed advanced production in niche areas.[192] India and Pakistan have large and broad-based arms industries but still lack more sophisticated R&D and industrial capacity.

In contrast, local capacities for most countries in South East Asia (Indonesia, Malaysia, Thailand and Viet Nam) are still concentrated in low-tech production and the MRO of foreign systems. However, they are gradually applying their indigenization policies through technology transfers and partnerships. For many countries at this stage, land and marine systems are often the sectors with strongest domestic production capabilities, whereas aerospace advances have proven to be slower.

There are two opposing trends regarding the ownership and structure of the arms industrial bases of states in the region, often in alignment with key features of the state's economy: in 7 of the 12 countries, state-owned companies and military-run

[191] Bitzinger, R. et al., 'Locating China's place in the global defence economy', Study of Innovation and Technology in China (SITC) Policy Brief no. 28, University of California Institute on Global Conflict and Cooperation, Sep. 2011, p. 2.

[192] Wezeman et al. (note 4).

Table 15.2. The top 50 arms-producing and military services companies in the Indo-Pacific region, 2020

All sales figures are in millions of current (2020) US dollars.

	Company	Country (HQ)[a]	Arms sales, 2020	Total sales, 2020	Arms sales as a share of total sales (%)
1	China North Industries Group Corp. (Norinco)	China	17 926	70 997	*25*
2	Aviation Industry Corp. of China (AVIC)	China	16 981	67 923	*25*
3	China Aerospace Science and Technology Corp. (CASC)[b]	China	16 807	38 564	*44*
4	China Electronics Technology Group Corp. (CETC)[b]	China	14 612	34 302	*43*
5	China Aerospace Science and Industry Corp. (CASIC)[b]	China	11 871	37 686	*32*
6	China South Industries Group Corp. (CSGC)	China	5 363	33 859	*16*
7	China State Shipbuilding Corp. (CSSC)[b]	China	4 904	48 209	*10*
8	Mitsubishi Heavy Industries (MHI)[c]	Japan	4 421	34 657	*13*
9	Hindustan Aeronautics	India	2 968	3 124	*95*
10	Kawasaki Heavy Industries (KHI)[c]	Japan	2 444	13 943	*18*
11	Hanwha Aerospace[d]	South Korea	2 245	4 510	*50*
12	Indian Ordnance Factories	India	1 897	1 935	*98*
13	ST Engineering	Singapore	1 885	5 221	*36*
14	Korea Aerospace Industries (KAI)[d]	South Korea	1 716	2 384	*72*
15	National Chung-Shan Institute of Science & Technology (NCSIST)	Taiwan	1 692	1 799	*94*
16	Bharat Electronics	India	1 483	1 901	*78*
17	China National Nuclear Corp.	China	1 468	32 653	*4*
18	LIG Nex1[d]	South Korea	1 357	1 357	*100*
19	Fujitsu[c]	Japan	1 322	33 625	*4*
20	Hanwha Corp.[d]	South Korea	1 167	3 398	*34*
21	IHI Corp.[c]	Japan	1 042	10 425	*10*
22	Austal	Australia	922	1 084	*85*
23	Mitsubishi Electric Corp.[c]	Japan	917	39 261	*2*
24	Daewoo Shipbuilding & Marine Engineering (DSME)[d]	South Korea	834	5 959	*14*
25	Thales Australia[b]	Australia (France)	831	1 128	*74*
26	BAE Systems Australia	Australia (UK)	810	853	*95*
27	Raytheon Technologies Singapore[b]	Singapore (USA)	760	1 169	*65*
28	Hyundai Rotem[d]	South Korea	697	2 361	*30*
29	NEC Corp.[c]	Japan	648	28 045	*2*
30	Poongsan Corp.[d]	South Korea	600	1 648	*36*
31	Hyundai Heavy Industries[d]	South Korea	548	12 633	*4*
32	Mazagon Dock	India	547	547	*100*
33	CSBC Corp.	Taiwan	520	859	*61*
34	Toshiba Infrastructure Systems & Solutions Corp.[c]	Japan	472	6 284	*8*
35	Rheinmetall Defence Australia	Australia (Germany)	463	463	*100*
36	Boeing Defence Australia[b]	Australia (USA)	458	458	*100*
37	Pakistan Aeronautical Complex[bf]	Pakistan	450	450	*100*
38	Aerospace Industrial Development Corp. (AIDC)	Taiwan	422	714	*59*
39	Lockheed Martin Australia[e]	Australia (USA)	419	419	*100*
40	ASC	Australia	402	406	*99*

	Company	Country (HQ)[a]	Arms sales, 2020	Total sales, 2020	Arms sales as a share of total sales (%)
41	Cochin Shipyard	India	326	381	*86*
42	Viettel High Technology Industries Corp.	Viet Nam	323	1 500	*22*
43	Bharat Dynamics	India	259	259	*100*
44	DRB-Hicom Defence Technologies (DefTech)[b]	Malaysia	219	3 131	*7*
45	Thales Singapore	Singapore (France)	214	454	*47*
46	Hitachi[c]	Japan	213	81 766	*<0.5*
47	Subaru Corp.[c]	Japan	210	26 511	*1*
48	Ashok Leyland	India	207	2 068	*10*
49	Komatsu[c]	Japan	204	26 511	*1*
50	Hyundai Wia Corp.[d]	South Korea	176	5 588	*3*

Notes: Rounding in this table is to the nearest full number.

[a] Unlike the global SIPRI Top 100, this regional top 50 list includes foreign-owned subsidiaries independently, indicating the location of the headquarters (HQ) of the parent company.

[b] The arms sales figure for this company is an estimate with a high degree of uncertainty.

[c] Data on Japanese companies was provided by the Mitsubishi Research Institute.

[d] Data on South Korean companies was provided by the Korea Institute for Industrial Economics and Trade (KIET).

[e] Data on this company was provided by *Australian Defence Magazine*.

[f] Figures for Pakistan for 2020 are unavailable. These figures are for 2019, converted to constant 2020 dollars.

entities are dominant, whereas private industrial conglomerates or foreign companies are the top contractors in Australia, Japan, South Korea and Malaysia. Taiwan has a combination of state-owned and private companies, largely due to privatization of state-owned producers. Nonetheless, a diverse cluster of private sector SMEs is active in all 12 countries, with capacities that vary from supplying bigger producers to independently producing end products and systems.

Uncrewed maritime vehicles

Despite the limited data available for the third indicator, on development of USVs and UUVs, it provides some approximation of how self-reliant some governments in the Indo-Pacific region are when it comes to uncrewed maritime vehicles. This indicator was used as a proxy for capabilities in emerging military technologies.

A government's decision to develop either USVs or UUVs, or both, reflects its strategic priorities. For example, Indonesia and Malaysia both prefer pursuing capabilities in operations other than war, such as patrol or counter-piracy. As a result, their R&D programmes tend to prioritize uncrewed maritime vehicles associated with such missions. In contrast, China and Japan have both been developing a range of USVs and UUVs to pursue full-spectrum capabilities ranging from surveillance to anti-submarine warfare.

Most USV and UUV programmes in the region remain at a testing or prototype stage. Among the few countries with operational naval autonomous systems, only China and Thailand have developed such systems locally, whereas Australia, South Korea, Indonesia and Singapore have foreign-supplied or cooperative designs in service. Both Australia and Taiwan have advanced programmes under planning, but there is little substantive information on their progress. In countries where state ownership is predominant in the arms industrial base, the key actors remain state-owned research centres (e.g. China or Taiwan) or universities (Thailand), and in many other cases government entities are involved (e.g. the navy and the DSO in Singapore; DAPA in South Korea, and the ATLA in Japan). However, the private sector leads the domestic effort in Australia and also, surprisingly, in India (notably Larsen & Toubro).

This indicator particularly benefits Singapore, which ranks relatively high in this area and boosts its overall score (see table 15.1). However, it still relies to a large extent on cooperative ventures, including with another regional actor, Taiwan.

Outlook

Wide disparities remain within the Indo-Pacific region when it comes to self-reliance in arms production. East Asian states (China, Japan and South Korea) are generally more self-reliant than those of South East Asia (Indonesia, Malaysia and Thailand). Australia, Taiwan and Singapore form a middle ground between these two subregional groups.

This reflects the ongoing challenges for countries without an advanced industrial manufacturing base to develop their arms-production capabilities in order to sustain the needs of their armed forces. In particular, in the case of South East Asian states (excluding Singapore), imports as a share of total acquisitions remain close to 100 per cent, but at the same time they have implemented a policy of diversifying arms suppliers to avoid being overly dependent on any single supplier. Developing domestic MRO capabilities is one way for these states to enhance their self-reliance. Another potential way to achieve this would be to increase cooperation in armament programmes at a subregional level, notably via the Association of Southeast Asian Nations (ASEAN). Previous attempts at developing intra-regional cooperation among ASEAN members were made in 2009–10 but did not lead to concrete results.[193] Cooperation would not increase national self-reliance but could contribute to a form of regional self-reliance while fostering interdependence among neighbours.

Beyond ASEAN, opportunities for regional cooperation could take place in the area of emerging military technologies. In the domain of uncrewed maritime vehicles explored here, most projects are still at the research and development stage. The operationalization of these programmes remains limited. Yet, pooling and sharing of resources and knowledge could prove fruitful, in particular when it comes to applications for operations other than war, such as counter-piracy and humanitarian and disaster-relief missions, which can provide common ground for countries in the region.

Strategically, this report's results show that, to some extent, monitoring of weapon flows only remains relevant for countries where imports still compose a large proportion of their total procurement. For others, this measure is insufficient to generate a full picture of their armament dynamics since domestic arms-production comprises an increasing proportion of arms acquisitions. Existing international confidence-building and arms control instruments, such as the ATT and UNROCA, are thus insufficient. The ATT focuses entirely on transfers of arms between states while UNROCA, which does include voluntary reporting on domestic procurements, receives a relatively low response rate.[194] Existing and future international confidence-building and arms control instruments should thus also try to capture domestic arms-production capabilities.

Overall, this report contributes to knowledge and debates on armament trends and military modernization in the Indo-Pacific on three counts. First, it provides a quantitative assessment of national self-reliance in arms production in the region in terms of the relative size of arms companies and the proportion of domestic weapon

[193] Grevatt, J., 'ASEAN defence industry collaboration still a long way off', *Jane's Defence Industry*, 5 Oct. 2010; and Grevatt, J., 'ASEAN advances defence co-operation projects', *Jane's Defence Weekly*, 21 June 2019.

[194] Wezeman, P. W., Béraud-Sudreau, L. and Wezeman S. T., 'Transparency in arms procurement: Limitations and opportunities for assessing global armament developments', SIPRI Insights on Peace and Security no. 2020/10, Oct. 2020.

systems in total arms procurement. Second, it introduces an aspect of arms-production capabilities that has so far been largely underestimated and where the literature is still scant: the industrial dimension of emerging military technology. In this regard, the comparison of programmes for naval autonomous systems in the Indo-Pacific region and their levels of development is an important contribution. Third, in a region where tensions among neighbours are rising, this report contributes to transparency with regards to levels of self-reliance in domestic arms production, allowing for an independent assessment of the region's respective arms industries.

The new data produced for this report opens new research questions worth exploring for a better understanding of the expansion of military capabilities in the region. Researchers and policymakers can use the new data to further explore the domains in which Indo-Pacific governments have developed the most capabilities, and they can also further explore the conditions for success or failure in developing a domestic arms industry. Two dimensions of arms industrial capabilities that are significant in the lower tiers of the self-reliance ranking are systems integration and maintenance, repair and overhaul. Neither could be fully captured by the indicators used here. Further research should be conducted on MRO capabilities in the Indo-Pacific as a support function of the national armed forces, as well as on self-reliance when it comes to components and their integration.

About the authors

Lucie Béraud-Sudreau (France) is the Director of the SIPRI Military Expenditure and Arms Production Programme, where her work focuses on the dynamics and implications of global military spending, arms production and transfers. Previously, she was a Research Fellow for Defence Economics and Procurements at the International Institute for Strategic Studies (IISS).

Xiao Liang (China) is a Research Assistant in the SIPRI Military Expenditure and Arms Production Programme. He collects and analyses data on military spending and the arms industry. His research areas cover the opportunity costs and reduction of military spending, the relationship between military aid and development assistance, and regional trends in the Asia-Pacific.

Ming Sun (United States) is a former intern in the Military Expenditure and Arms Production Programme.

Siemon T. Wezeman (Netherlands) is a Senior Researcher in the SIPRI Arms Transfers Programme. He has contributed to many SIPRI publications since 1994, including SIPRI's annual reviews of global trends in arms transfers, arms industry, military expenditure and multilateral arms embargoes.

STOCKHOLM INTERNATIONAL PEACE RESEARCH INSTITUTE
Signalistgatan 9
SE-169 72 Solna, Sweden
Telephone: +46 8 655 97 00
Email: sipri@sipri.org
Internet: www.sipri.org